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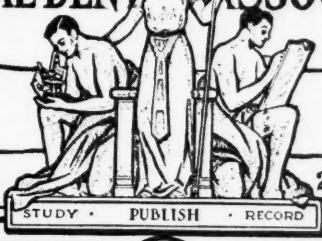

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OCTOBER, 1919

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Practical Application of the Principles of Oral Prophylaxis in Dental Practice.—*Gearhart.*

Work in the Rochester Schools.—*Burkhart.*

Development of Periodontia.—*Hoff.*

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The Research Department.—*Pond.*

Short and Bibliographed Papers the Best Papers.—*Editorial.*

Tuberculosis is Curable and Preventable and Yet 150,000 Deaths Last Year. Why?—*Editorial.*

Official Program

Twenty-third Annual Session

New Orleans October 20-24

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CANAL STREET, NEW ORLEANS, LA.

National Dental Association Meeting, October 20-24, 1919.

THE JOURNAL
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VOL. 6 OCTOBER, 1919 NO. 10

Original Communications.

THE NECESSITY FOR EARLY DIAGNOSIS OF PERIODONTAL DISEASES.

By Andrew J. McDonagh, D. D. S., Toronto, Canada.

(Read before the National Dental Association at Its Twenty-second Annual Session, Chicago, Ill., August 5-9, 1918.)

MAY I express my appreciation of the honor conferred on me by being asked to present this paper before you and also to say that whoever was responsible for appointing the subject to me, could not have chosen one upon which I would more gladly speak, notwithstanding the fact that I feel hopelessly incapable of handling the subject as it should be handled. I will try, however, to be as short and as concise as possible.

One might ask just here, what is the necessity for early diagnosis in any disease? And naturally we would answer, to minimize, or if possible to eliminate, the baneful effects of that disease, and there is no difference in this respect between a periodontal disease and a disease in any other part of the body.

However, there are some peculiarities which are of very great interest to us. We must consider the periodontal destruction in its relation to constitutional disorders and its local effects and manifestations.

There are two phases of its relationship to constitutional disorders, that is, as a result of constitutional disturbances and as a causative factor in constitutional disturbances.

When periodontal destruction is the result of constitutional disorders, it may be and sometimes is a very valuable diagnostic entity.

Years ago, many observers reported

cases where definite indications of constitutional diseases were made manifest at the gingival margin, in fact we read in Burchard's that Dr. Rhein found, after repeated examinations of hospital patients, that, "Marginal gingivitis was an accompaniment of typhoid fever, tuberculosis, malarial disorders, acute rheumatism, pleurisy, periocarditis and syphilis, among the acute diseases. Of chronic diseases, it was commonly observed in cases of gout, diabetes, chronic rheumatism, several forms of nephritis, scurvy, chlorosis, anemia, leukemia, and pregnancy.

It is also well known that Bismuth

Figure 1.

poisoning, lead poisoning and many other general poisons, very early display themselves by the appearance of the gum margin. I take it, that it is not necessary for me to elaborate extensively this phase of the subject. It seems a self evident fact, that in these cases, at least, in order to be of any use to the attending physician, the earlier those periodontal diseases are observed, the better all around.

Regarding constitutional diseases, the result of periodontal destruction; there are many phases of this particular part of the subject and I have stated publicly before and I repeat it at the present time, that it is unwise to assert and it cannnot be proven that all gingivitis and all periodontal destruction result in constitutional disorders, but that there are instances where the constitution has been ruined by the absorption of poisons at the gingival margin, very few professional men, either dentists or physicians will at present attempt to gainsay. I have had in my own practice, instances where the gum margin was scarcely inflamed at all, just the slightest irritation apparent, and yet, as a result the patient has suffered inordinately.

I remember a case reported by Dr. Webster, a lady came to him with a slight gingivitis, suffering so severely from neuralgia that it was undermining her health. After he cleaned up the mouth the neuralgia entirely disappeared and the constitutional disturbances which accompanied the neuralgia also disappeared. The patient left him for a time and a year or so afterwards the neuralgic pain returned. Her physician doubted the idea of her teeth causing the trouble, however experience taught her and she went back to Dr. Webster and was again completely cured by the same treatment as before.

I mention this case as one typical of many we meet in our offices, and Figure No. 1 shows an X-Ray of the mouth of a patient, suffering in this way, who came under my care. A neuralgia of this type may be caused in several ways, a bi-product of the micro-organism in the gingival crevice, may be sufficiently irritating thru the tissues of the teeth to cause an irritation of the nerve in the pulp or reflex thru the nerves of the pericementum, or there may be an absorption of micro-organisms or micro-organic products thru the soft tissues, which may act constitutionally on the nerves. I want to speak of a section showing a tooth in position in the jaw and surrounded by the gum tissue, which was exhibited by Dr. Hartzell in Minneapolis, the last time the dental teachers convention was held there. This section shown by Dr. Hartzell was very similar to the one made by Dr. Harold Box of Toronto, a slide of which I am showing you here.

There is no more gingivitis shown than we have in this one simply a gingival irritation from the result of some local irritant, which one would think scarcely could do harm, yet Dr. Hartzell showed us and you see here that the blood vessels in the gingival space are quite open, where the mucous membrane is broken. (Figures 2 and 3.)

As it was expressed at the time by some one present, the surface in the gingi crevice was "raw", and we know that that surface must have been covered by a fluid containing micro-organisms; that being true, is it necessary for me to ask or to answer the question, what is the use in these cases of early diagnosis?

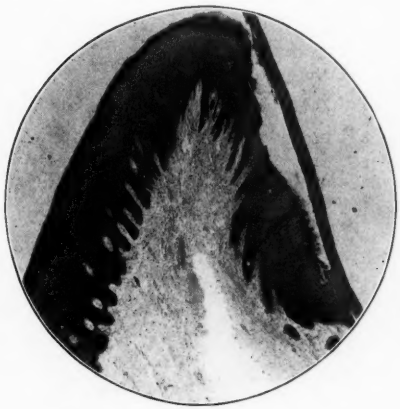


Figure 2.

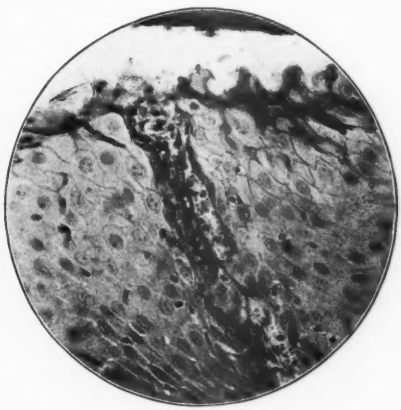


Figure 3.

Let us go on a little further, if we do not discover the disease until it has existed for some time, what is the result? We have seen that the lining surface of the gingival crevice is sometimes destroyed not always, but often enough to make a dentist feel that he is not performing his duty to the public, that he is not preserving the health of his patients, in other words that he is not true to his trust if by his neglect and his lack of observation, he does not recognize the fact that a process is going on in the mouths of his patients which may be, and in the cities, probably will be injurious to the health of the individual. But taking it for granted that this initial gingivitis has no injurious influence on the health of the patients, take it for granted that the mucous membrane in the gingival crevice holds intact, what is the harm of not discovering periodontal destruction in its early stages? That is answered by the slides of Drs. Hopewell-Smith, Hartzell, Arthur Black and many others.

When we have gingivitis connected with a local irritant and by that I mean in contra-distinction to gingivitis resulting from such poison as iodine, or bismuth, etc, there is a solution of the continuity of the lining of the gingival crevice at the base of that crevice. Great numbers of plasm cells and later on leucocytes or perhaps both together congregate to take part in the defense (Figure No. 4) and the surrounding bone is dissolved away. After this process has been going on for some time, and in some cases not a very long time quite an amount of the investing tissues of the tooth is destroyed and destroyed never to be built up again to its former contour. But this is not all, altho this is bad enough, if we look at the slide of

Hopewell-Smith we will see that even from a small amount of injury at the gingival margin, far down in the bone and in the pericementum, unbelievable, unless shown by a slide, the tissues are highly disturbed and abnormal conditions are established. (Figure 5).

Very interesting in reference to this subject is the statement made by Hopewell-Smith, that from his observations, the crest of the alveolar process commences to break down immediately. Nature has finished building it, I have

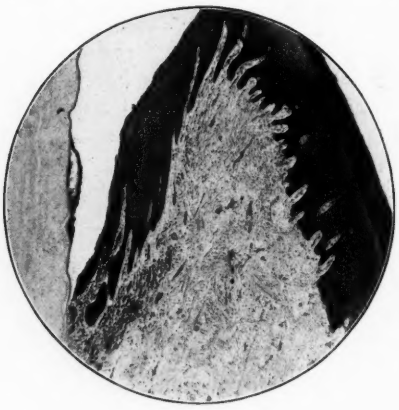


Figure 4.

seen some of his slides and they certainly go to prove that fact. Is it not possible however that an irritant in the gingival crevice might be responsible for this breaking down, in at least a great many cases? We know from experience that a great many individuals have gingival irritation and very little is thought of it, and Hopewell-Smith does not say when speaking of these slides, whether he had examined carefully to see if there was gingival irritation or not. He has found, as many other investigators have found, that micro-organisms make a place of habitation of the gingival crevice, and if we recognize that as a fact, it is quite possible to put those tissues in such a good hygienic condition and such a state of health that before any great amount of destruction has taken place, the irritation will be eliminated.

At a meeting of the Toronto Dental Society last winter Dr. Arthur Black showed a slide which demonstrated the fact that from a pocket formed in the gingival portion of the periodontal tissues, infection had traveled in the lymphatics toward the apical part of the tooth, extending perhaps half the way between the gingival crevice and the apex, showing that the infection in this

Vertical section thru canine and bone of right side of mandible of man aged thirty-nine. Pyorrhea not so marked as in previous case. Tissues over external aspect (×35). A, Dentin. B, Cementum. C, "Pocket" of gum, the edge of which is attached to the margin of cementum. D, Slight desquamation of oral epithelium. E, Slight inflammation of gum. F, Edge of alveolar bone transformed into osteoid tissue; bone lacuna and corpuscles indistinguishable. G, Hyperplastic periodontal membrane; bloodvessels injected. H, Normal bone.

Figure 5.

particular case was traveling or being carried much further than the pocket would indicate, demonstrating also the fact that the farther the infection was permitted to travel, the more difficult it was to reach it or effect a cure. I am showing here a slide (Figure 6) which may easily be taken to represent this condition. The pocket in this case is quite small but the irritation (and this

is not uncommon) to the teeth and the surrounding tissues was so great that the patient wanted to have the teeth extracted. After treating the teeth, that is after curetting the pocket which is here shown, he would have relief for a short time but the same old trouble would return in a few days. After making this X-ray I discovered that the infection was much deeper than the pocket would indicate, consequently I discovered the reason of the failure to permanently relieve him. Now if this pocket had been discovered early enough, if prophylactic measures had been used, in all probability we could have prevented the more serious manifestations.

Figure 6.

Let us look at it from another standpoint. While the disease is confined to the gingival portion of the gum, where there is a free blood circulation in the soft tissue and where there is a chance of the pocket being covered by mucous membrane, or protected to a certain extent by fibrous tissue, we are not so apt to have an infection of the underlying tissues, but let that destruction extend into the bone where you have an exposed bony surface, an unprotected absorbing cavity, and you know by experience, the results.

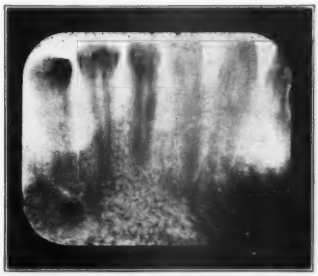


Figure 7.

Take a case like this slide (Figure 7), note the extent of the unprotected bone, or take a case like this one (Figure 8)

Figure 8.

where the bone is being absorbed out, in every interproximal space, and compare those with the conditions which we find when these diseases just started,

such as this slide (Figure 9) and it is not necessary to ask, of what use would it be to discover these periodontal diseases in their early stages?

There is one particular phase of peridontoclasia which has been brought to the notice of the profession in the most gratifying manner by Dr. Paul Stillman, that is the effect of traumatic occlusion on the periodontal tissues. Traumatic occlusion and all forms of malocclusion have a very potent and baneful influence on the investing tissues of the teeth, and that influence is demonstrated early in them. The teeth become loosened, sore, and have to be extracted, but had a dentist recognized that condition early enough, or had the patient been properly instructed when young, or properly taken care of and normal occlusion established, there would not have been that factor in causing destruction, and disaster would have been averted.

On the other hand traumatic occlusion is likely to appear later in life as the cusps of the teeth become unevenly worn and the stress of mastication and occlusion unevenly distributed. In each case

Figure 9.

the gingival tissues. Malocclusions when not rectified will undoubtedly result in the loss, or reduction to uselessness of numberless teeth. But malocclusion can be rectified sometimes by a periodontist with very little trouble, often, however, these cases are better taken care of by an orthodontist. And speaking from the standpoint of the periodontal tissues, the sooner the malocclusion is rectified the greater the chance of success of our treatments. Sometimes the periodontist in looking over a case will say that it is impossible because of the age of the patient, to change the occlusion so that it may be made normal, and this I have found often to be true, and as a consequence, no amount of treating of the periodontal tissues can save the gingival tissues will show a deepening of color and other diagnostic indications which warn the periodontist or the observant dentist that some deleterious process is progressing. At this stage it is a comparatively easy matter to arrange the occlusion so that it will be practically normal. The investing tissues will be relieved of their unnatural burden and stress and sometimes without any further treatment normal conditions will be established. Allow this abnormal condition to proceed, however, and the extraordinary irritation or over stimulation of the tissues will cause their breaking down and the disease to progress.

Partial dentures which have clasps encircling teeth to hold them in place,

often are the cause of the loss of teeth and the next two slides are eloquent in telling us the results of ill-fitting clasps. Figure 10 shows the alveolar bone in position, not broken down, the alveolar crest of periodontal fibres in place and the tissues normal. Figure 11 shows the crest of bone after an irritation from a clasp, the irritation being of short duration, and you will perceive that the bone has disappeared and some of the fibres also. You can see the line showing where the bone originally was.

These slides were shown by Dr. W. E. Cummer at New York, where he read

Figure 10.

a paper which was afterwards published in the Allied Journal of September, 1916. I believe these specimens were prepared by Dr. Harold Box.

Now we have spoken of a number of different phases of the disease which present themselves to us and made a study of their beginning, but do we realize how very nearly universal in this civilized age, indications of abnormality in the gingival tissues exist, even in the very young? A slight gingivitis is almost universal and is overlooked, unfortunately by a great majority of our profession.

It is either not observed or not considered serious. Reminds one of a doctrine that used to be preached at one time regarding caries, in that a cavity, unless it was a good size was not large enough to fill. Time and experience soon showed the profession, at least those who desired to see, that this was a wrong doctrine, that any form of caries was a menace to the teeth and the sooner decayed tissue was removed and replaced by something that did not decay the more benefit accrued to the patient. The case of the gingival tissues is no different. It is absolute folly to allow gingival irritation to proceed till you have a deep infection of the bone, worse than folly to allow the disease to proceed until it is impossible to make a cure.

How much easier it is to treat initial

Figure 11.

gingival irritation than treat the condition which obtains after torsion has taken place and the teeth twisted in their sockets. If the gingival crevice were curetted and thoroly sterilized before there was any serious periodontal destruction, I believe that at least ninety per cent of all periodontoclasia would be prevented and this is not a mere conjecture. We have all seen in our profession numbers of cases that go to prove this fact, but it is pretty hard for us to prove it to the satisfaction of others. The skeptic is apt to say, "there would not have been any disease there in any case and the work of prophylaxis was unnecessarily done."

I have with me a number of models, and we have here the slides made from those models, which I think you will agree with me, go a long way towards

proving the contention we make in this regard. Some dentists, in fact practically all dentists at the present time, when putting on porcelain crowns or a gold crown for that matter, thoroly curette and sterilize the gingival crevice, not only that, they reduce the periphery

Figure 12.

of the root in a great many cases, and I will show you slides here of crowns put on when the roots were treated in this way which have evidently been the factor in preventing recession of the gum or destruction of the periodontal tissues. I have seen a number of cases where the teeth which were crowned

Figure 13.

were the only solid teeth in the mouth, but this of course you can not show in a model but you can show and those models do show that the teeth which were crowned in these cases are the only teeth in the mouth about which recession has not taken place. For instance in Figure 12.

Figure 12.—Patient 30 years old, upper right lateral crowned at the age of 23, gums on all the other teeth have receded, but there is no abrasion of natural teeth and no recession of gums around crowned tooth.

Figure 13.—Patient 48 years old, crown on upper left lateral about 15

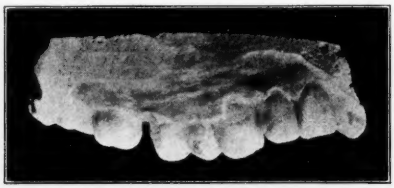


Figure 14.

years or when patient was about 30 years of age. In all probability the gums had receded a little at that time, since then no recession on the crowned tooth but the gums have receded on all the other teeth in the mouth, also marked abrasion.

Figure 14.—Patient 38 years old, gold telescope crown on the upper right first bicuspid for 14 years, leaving patient 24

Figure 15.

years of age when the crown was put on. Gums receded on all the other teeth in the mouth, also slight abrasion.

Figure 15.—Patient 35 years old—upper right lateral no band crown, has been on 12 years, put on when patient was 23 years old. Gums receded on all the other teeth but that one. No abrasion.

Figure 16.—Patient 20 years old, right upper central is a banded crown put on at the age of 15 years, recession taking place on all the other teeth in the mouth upper and lower.

Now I do not claim that crowning is always good practice, on the contrary in

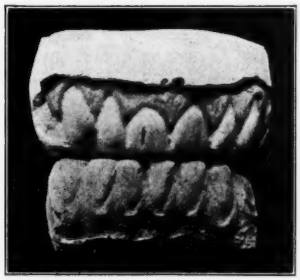


Figure 16.

my radiographic work, where I have taken thousands of X-rays of crowns, I must say that it is appalling the number of septic areas which we find at the apices of the roots of the crowned teeth. These slides which I have shown you, are of teeth which were crowned properly, the roots filled properly and taken because they were the kind of crowns which we

Figure 17.

want to demonstrate, but the gums will not recede about the roots of a tooth which is properly treated at the gingival margin, no matter whether the apex is septic or not.

This fact I believe is the most powerful argument I have to prove that all periodontal tissues should be closely examined and at the first sign of abnormality, be it the slightest, should be taken care of by the most careful, conscientious and skillful operator.

Discussion.

Gillette Hayden, Columbus, Ohio.

I feel that this paper is of too much importance not to be discussed a little, even in hot weather. I think that we have all neglected periodontal diseases both in our minds and in our practices. This paper and the one of Dr. Hoff's that went before it, place before us two things of great concern, the first of which is early attention, and the second early recognition of existing periodontal disease. Dr. Hoff stated that if we could take care of the children better and earlier we could accomplish many more things of great moment, and Dr. McDonagh takes the thought further and carries it to the adult mouths which we see daily in our practices. If we could read all that are in these mouths for us to read, I think I am conservative in saying that at least 75% of the suppurating and non-suppurating periodontal cases would be eliminated from our practices, because they would never be permitted to develop to these stages. Surely early recognition of periodontal disease is of great worth and of great moment to us all.

W. G. Ebersole, Cleveland, Ohio.

I am very much interested in the last slide shown in the crown proposition. Many years ago I had an experience with a number of crowned teeth and I learned then to avoid band crowns. My experience is that the band crown produces additional recession instead of less. I am inclined to think that a great deal of the recession around the other teeth was due to somewhat excessive or faulty brushing. I was very glad to learn that some action had been taken in regard to standardizing the brushing. I have been wondering if there was not

some tenderness around those crowned teeth which led the patient not to scrub them so vigorously with the brush.

Austin F. James, Chicago, Ill.

I have been watching these things closely myself for the last few years, and I would prefer those that have a smooth surface band as being kept cleaner than the average gingival margin. I had occasion a few years ago when Doctor Martin was in the city to see a number of his cases. He had some remarkable cases in extensive bridge work, and I found that he had the ability after he got the gold band up on the abutment tooth of making it smaller and actually making it fit. He carried it up very high on the tooth where the gums had loosened up and got the most remarkable results in many cases. There was a perfectly smooth surface for the gum. I find in perfectly natural teeth that we have gingival irritation and I would say that that was the cause of the recession. There is often a roughened gingival roll of enamel that has caused a destruction of the tissue and recession. I do not think the trouble is always due to excessive brushing or improper brushing.

Andrew J. McDonagh (closing): In answer to Dr. Ebersole and Dr. Hayden I may say that I made the paper as brief as possible on account of the heat and the admonition that was given to me by a couple of friends as I was coming to the platform. I had intended in going over the paper to make some explanatory remarks. I think Dr. James has hit the nail on the head.

I have made some impressions of crowns that were put on without taking the extraordinary care which has been shown in some of these models and the gum was red and swollen and had not receded. I have a model here showing this condition a piece of metal imbedded in the plaster showing the depth of the pocket. I have not shown a slide of it because I could not use it in the theme of my paper. The point which I was demonstrating in this paper and which the models and slides seem to prove is, that when the root is properly trimmed and prepared for the crown, the gum does not become swollen or inflamed and does not shrink. There is a fact involved in this statement which would lend itself to any amount of elaboration but which I would not be permitted to discuss at length at the present late hour. I cannot refrain from drawing your attention to one essential point involved, because it has greatly to do with the reasons for early diagnosis in periodontal diseases. Let me draw your attention to Figure 4, where you have the mucous membrane broken at the bottom of the pocket and the plasma cells in great evidence; consider this condition at the time you are putting on a crown and I ask you what is the effect of trimming the root of the tooth under the gingival margin to receive the crown? One unfailing result is the formation of a cicatricial tissue, a fibrous tissue where your plasma cells now are and probably the stimulation of the growth of the epithelium, either or both of which will protect the underlying tissues from micro-organic invasion. This is at the bottom of a great deal of our success in prophylactic treatment.

Someone asked if I objected to a banded crown; the models that I show here would indicate that banded crowns were good, notwithstanding that fact and altho this paper has not anything to do with banded or any other crowns from the standpoint of crowns. I would say I dislike banded crowns because it is exceedingly difficult to get the ideal in a banded crown and nine out of ten of us can rarely get the conditions shown in these models.

THE PRACTICAL APPLICATION OF THE PRINCIPLES OF ORAL PROPHYLAXIS IN DENTAL PRACTICE.

By Clyde M. Gearhart, D.D.S., Washington.

(Read before the National Dental Association at Its Twenty-second Annual Session, Chicago, Ill., August 5-9, 1918.)

I SAT beside an interested spectator at a movie, not long since, where there was being projected a film, relative to mouth hygiene. Among the interesting subjects thrown on the screen were some marked pathological conditions, brought about by imperfect root-canal technic; the visualization of periclasia in its worst forms; the unwholesome conditions of mouths that were strangers to personal care and then followed a series of educational hints pertaining to various remedial measures employed in obtaining and maintaining health in the mouth At the conclusion of the entertainment, I heard the spectator thoughtfully and feelingly remark to his companion: "These damned dentists are getting next to a lot of things lately".

It is gratifying and refreshing to hear such expressions of faith regarding our progress, but I regret to state that I do not believe I can wholly concur in the gentleman's view. There are numbers of dentists who are not "next to things lately", and after a watchful waiting of several years, I have my doubts as to whether some ever will "get next".

The practical application of the principles of Oral Prophylaxis in dental practice is in dangerous hands, if it is in the hands of one who does not thoughtfully and religiously believe in the fundamental principles and teachings. Oral Prophylaxis cannot be practiced wholly by the dentist. If he does not have the hearty cooperation of his patient, there is no such thing as Oral Prophylaxis. However, to obtain the hearty cooperation of the patient, one must needs be able to impress the patient, not only with the desirability of cooperation, but with the absolute necessity of it, and to gain the average patient's confidence, your own sincerity and abiding confidence in the efficacy of the treatment must be breathed into every syllable of explanation. I mention this phase for the very good reason that I have heard dentists speak in a manner regarding the value and merits of Oral Prophylaxis, that has caused me to infer that they themselves were skeptical as to its merits. So, I believe that one of the cardinal principles in the practice of Oral Prophylaxis, is that the practitioner be an earnest disciple of its teachings.

The over-zealous optimist in Oral Prophylaxis is a detriment to the profession. Many complaints have been laid at the door of our school, thru unfulfilled promises in the prognosis of cases given by inexperienced, over-enthusiastic practitioners, who had a smattering of knowledge, and glibly made statements concerning cures which they nor anyone else could possibly have effected. The inevitable result of exaggeration is loss of confidence in Oral Prophylaxis and in our entire profession.

I do not believe it was the intention of the essay committee, in assigning me this particular subject, that I should dwell upon the technic of Oral Prophylaxis. I am satisfied that each and every one of my auditors is familiar with the elementary principles of Oral Prophylaxis; so, I will dwell but momentarily upon that.

Some years ago, I heard a short definition of Oral Prophylaxis, which I have always liked to use when defining that term. Who the author is I do not remember, but someone said that "Oral Prophylaxis is a surgical interference for the prevention of disease in the mouth". The technic and methods of procedure employed in obtaining this end to a greater or lesser extent, have become partially standardized within the past few years. A further standardization, however, is demanded. There seems to be enough variance of opinion and method among men and women engaged in the practice of Oral Prophylaxis, to arouse apprehension in the minds of patients, particularly those who go from city to city and avail themselves of the services of men and women engaged in that work.

For instance: A man in the east may believe that the rotary method of brushing the teeth is correct; whereas, the man in the west, who sees the patient a little later, holds to a decidedly different opinion. The man in the north is enthusiastic in recommending a certain paste for the patient's use, while the man in the south declares emphatically, that paste should never be used, and gives the patient a prescription for a powder. The man in the east recommends the use of dental floss; but when the patient gets to the man in the west, he is told in no uncertain terms, that the use of floss is wholly unnecessary, and that, besides, it will in time, scarify the gum tissues. The man in the north prescribes the use of his favorite mouth wash, and the man in the south promptly declares that it has no remedial value, and is likely to do harm.

Differences of opinion such as these, certainly cannot impress the patient favorably, and inasmuch as they are in opposition to one another, it is impossible for all to be right. In order to inaugurate a program which will impress the principles of Oral Prophylaxis on the minds of our clientele with a minimum of doubt as to proper application, I have to recommend a closer standardization of principles.

It is fair to assume that the practitioner has the knowledge and skill necessary to put the teeth and contiguous structures in a normal condition. Having done so, the success of the treatment is absolutely dependent upon the patient's frequent and regular subsequent visits, in order to maintain that condition of health in the mouth. Patients who are predisposed to abnormal conditions need to be educated to the fact that the permanent success of the treatment is entirely dependent upon the subsequent visits, together with the personal care which they themselves must give.

It is a matter of common knowledge that there is a certain amount of skepticism in the minds of a great many patients, regarding the real merit of Oral Prophylaxis. One of the greatest obstacles we have to overcome is that of dissuading the patient's mind of the notion that Oral Prophylaxis is not a *habit*, but a real science. If, after a reasonable time we have not been able to convince the patient of the scientific value of prophylactic treatments, I am constrained to say that our efforts to further impress that patient should cease; for, I firmly believe that the foremost essential toward the successful practice of Oral Prophylaxis lies in the ability of the operator to convince the individual of the unquestionable worth and merit of the work.

The application of a certain amount of

psychology is deemed necessary to further the propaganda of Oral Prophylaxis. Organization or reorganization of one's office to the end that it may be put on a strictly Oral Prophylaxis basis, is essential.

A few persons skeptical as to the merits of the work may cause untold mischief and become a disturbing element in your practice. It is not believed to be good policy to overwhelm patients with learned views and ponderous matters of record in support of your work. There is nothing mysterious about the treatment. It is administered thru simple lines of procedure which should instantly impress patients as conducive in the highest degree to wholesomeness and cleanliness. As a matter of fact, in most instances, Oral Prophylaxis should appeal to the personal pride of the patient. Any patient who is not enthusiastic about the work after a fair demonstration of its merits, is a detriment to your practice.

It seems fitting at this time, when we meet as a section in collaboration with the Orthodontists, to address a few remarks to them. Perhaps one of the greatest objections to favorable consideration of having Orthodontia done, has been the seemingly progressive carious condition of the teeth, a condition that sometimes occurs coincidently with the insertion and maintainance of orthodontic appliances, necessary in the work. Personally, I do not believe that the Orthodontists are really responsible for all of the charges that have been placed against the appliances necessary to that science. I do believe, however, that in many instances, the conduct of the Orthodontist has been reprehensible when he has failed to insist upon the mouth and teeth being placed in a normal condition before the appliances were installed; and, I further believe that there are instances in which he is equally blameworthy for damage done to teeth thru failure to insist that his patients avail themselves of intelligent prophylactic treatment during the time that the teeth are under Orthodontic care. With the exception of perhaps a few isolated cases, progress of caries should be no more marked under orthodontic treatment than would be the case otherwise. But, if the orthodontist, in his haste to install his appliances, should overlook the fact that he is banding teeth where incipient decay has started, or where imperfect fillings have been placed, there can be no doubt that bands, and other means employed to correct abnormalities may produce a condition that hastens progress of tooth disintegration.

Aside from the Orthodontist being placed in a most embarrassing position in trying to explain away the reason why the progress of caries has made such inroads during his work, and aside from the fact that he must admit that he has not handled the case scientifically, in allowing such a condition to progress unnoticed, he has done the patient and the profession an irreparable injustice.

Cleaning the teeth does not constitute Oral Prophylaxis. I reiterate that Oral Prophylaxis is surgical interference for the prevention of disease; it is, therefore, incumbent upon the Orthodontist that before his work is undertaken, his little patients' mouths should be placed in a satisfactory prophylactic condition, and prophylactic treatment should be continued thruout orthodontic work.

I have recently been privileged to observe the workings of a retainer which I am quite sure all practitioners of Oral Prophylaxis will welcome with much delight. It is most effective in accomplishing the ends sought, and at the same time it is of such simple construction, and is so easily removed by

the patient, that its scientific value is greatly enhanced.

The retaining appliance which I have seen in Doctor C. A. Hawley's office in Washington and in the mouths of his patients, whom I have cared for during retention, is removable, and during its use has no bands whatever on the teeth. After a few months it is worn only at night and permits a perfectly normal condition of the teeth and gingival tissues. As the time of greatest danger from decay and gingival irritation is always during two or more years of retention when the patient is seen less frequently, the use of such a retainer will lessen to a great degree the danger spoken of above during orthodontic operation.

May I not take the opportunity here presented to remind the orthodontists of the presence of that delicate, vital periodontal membrane, so often abused by careless fitting of bands, and their cruel insertion under the gum, oftentimes causing total destruction of this most important membrane? One other reminder: constant care should be exercised in seeing to the removal of particles of cement that may be pushed ahead of the band when driving it home.

Action taken at the recent convention of the American Academy of Peridontology, effecting standardization of a definite technic prescribed for the care of the mouth, advanced a step in the direction of eliminating some of the shortcomings objected to. That Academy in offering its recommendations to the profession at large, does so, not unmindful of the fact that after a trial, some objections may be noted, but at least the foundation for a working basis has been established, whereupon may be builded the successful solution of a simple and efficacious method of taking personal care of the oral cavity.

A uniform, concentrated effort on the part of each and every member of the profession is essential in conducting to a successful termination the principles inculcated in the practice of oral prophylaxis. Meetings of the profession, in which various and varying views may be presented as in Common Council, will hasten the time when the disabuse of the absurd indulgence in mind, on the part of a number of our profession, that Oral Prophylaxis is a hobby, will have been brought about!

I bespeak unqualified success for the practitioner of Oral Prophylaxis who first of all, by the indisputable merits of the work, finds himself an ardent believer and devotee to its teachings. This same belief cannot fail to be reflected to his patients by his earnestness in every word and act. Sincerity of purpose is as readily recognized and appreciated in a dental procedure as it is in any other legitimate undertaking.

Simplicity in detailed explanation to patients of its merits and benefits is desirable. The degree of knowledge one really possesses about any given subject is measured in that proportion by his ability to present the subject in a simple, concise and logical manner.

Harrowing details of harm likely to befall patients who do not avail themselves of prophylactic care should be omitted. Elaborate procedures in conducting the work should be dispensed with. These are wholly superfluous, and unnecessary.

To epitomize oral prophylaxis is a surgical interference for the prevention of disease. Therefore, please to conduct your work in a surgical manner.

Intelligence, skill, surgical cleanliness, perseverence and sincerity of purpose, goes to make up what are generally conceded to be the necessary requirements in the practical application of the principles of Oral Prophylaxis in a dental practice.

DISCUSSION.

Dr. Frank M. Casto, Cleveland, Ohio.

Dr. Gearhart is to be commended upon his masterful presentation of this subject. He has touched upon a number of important points, which will sink in deeper and deeper, as they are given more thought and consideration.

He said that not infrequently a rumor would become current that because of an Orthodontic treatment the teeth of the patient had fallen out. Dr. Gearhart mentions this to show the great extremes at which rumors may go. It would be impossible, as you all well know, for such a thing to occur during an Orthodontic operation. One of the unpleasant conditions that the Orthodontist has frequently to contend with is the tendancy on the part of some person to attribute any trouble which may occur or develop while the patient is under Orthodontic treatment to the wearing of appliances. I know it to be a fact that when patients are under proper Orthodontic treatment, they suffer less from nerve strain, from shock, or from irritation of any kind to the soft tissues in the mouth, or from decay of the tooth, than do children who have not been under the care of an Orthodontist. The reasons are perfectly obvious. The patients are under close observation all the time. Care is taken to keep the mouth clean and healthy, and the patients are instructed thoroly in the use of the toothbrush, and hygienic care of the mouth. Many, many years ago, it might have been justifiable in some cases to charge to the wearing of Orthodontic appliances certain undesirable conditions that had developed in the mouth. However, that is not true in the modern practice of Orthodontia.

THE WORK IN THE ROCHESTER SCHOOLS.

By Harvey J. Burkhart, D. D. S., Director, Rochester Dental Dispensary, Rochester, N. Y.

(Read before the National Dental Association at Its Twenty-second Annual Session, Chicago, Ill., August 5-9, 1918.)

THE city of Rochester makes an appropriation of $20,000 a year for prophylactic work in the public and parochial schools, orphan asylums and church homes. The work is done under the direction of the Rochester Dental Dispensary, by licensed dentists, graduate dental hygienists and students in the hygienists school conducted by the Dispensary.

Equipment.

The equipment consists of a chair weighing about 200 pounds, considerably smaller than the regular dental chair. The chair is very simple in construction, and is provided with a mechanical lever for the purpose of raising and lowering. It is equipped with an ordinary cuspidor and shoes on the bottom of the legs so that it may be easily slid along the floor. There is also a small truck sent with each outfit to facilitate the rapid handling of the chair. A two drawer cabinet, the top of which is about 20 inches square, is provided for instruments, bottles for medicaments, cleaning powder, strips, wood points, etc. A foot engine is also provided. Electric sterilizers also go with each outfit, and where there is no electricity in the schools, suitable utensils are provided for the proper boiling and sterilizing of the instruments. With each outfit is sent a supply of towels, napkins, etc. Hampers are provided for the clean and the soiled linen. Each dentist or hygienist carries his or her individual set of prophylactic instruments. The operators are divided into squads of from two to ten, depending upon the size of the school, and each squad is in charge of a licensed dentist.

School Work.

Before a squad visits a school, literature, printed in English, Italian and Yiddish, is sent to the principal for distribution, calling the attention of the parents and children to the necessity and value of prophylactic treatment. On the bottom of each circular is a slip which may be signed by the parent and returned to the school, in case they do not wish to have their child's teeth cleaned. There is no ordinance or rule which compels children to have their teeth cleaned, if objection is made by the parent or guardian.

The clinic is held in the best available space that may be obtained in the school. In many, it is not possible to have a room set aside for this work, and in such cases, it is done in the corridors or most convenient place that may be found. In a large number of schools, the facilities for doing this work are very inadequate and poor, because few, if any school architects, have planned for a medical or dental clinic. School architects and authorities are beginning to appreciate the necessity for a properly arranged and lighted room for this work, and the newer plans will probably show a very great improvement in this direction.

The work is usually done by grades,

commencing with the kindergarten. However, this plan is always subject to change, due to the local conditions found in the various schools. The number of dentists and hygienists employed varies with the requirements.

During the last school year, 41 public schools, 27 parochial schools and seven orphan asylums and homes were visited twice. On the first visit, 33,664 children received prophylactic treatment, and on the second visit 41,860 were treated. On the first visit, there were approximately 15% of refusals, and on the second visit about 10%. Wherever the work was done, either in the public or parochial schools or orphan asylums and homes, it has met with the most cordial and hearty reception and approval. The cooperation on the part of the principals and teachers has been splendid, and in but a few instances has there seemed to be a lack of appreciation of the value of the work. While at first there were some obstacles to be overcome and some prejudice to be explained away, on the second visit, the reception accorded the operators was more cordial, and there were few instances where they did not receive a hearty welcome. The enthusiasm displayed by the principals, teachers and parents, and the cooperation on the part of the children themselves, has been most gratifying. While there were many misgivings at the start, with reference to the reception that would be accorded to the operators, it is with much pleasure that I tell you that we were very happily disappointed.

After the prophylactic work is finished, a survey is made of the mouth, and also an inspection by the operator in charge of the squad. If there is need for further dental service, extractions, fillings or anything else that needs correction, a card is sent to the parent of the child, stating that the child is in need of dental services, and urging an immediate visit to the family dentist, or in case they are unable to pay for dental services, to at once come to the Dispensary. The greatly improved condition of the children's teeth, we believe, is in a very large measure due to the prophylactic treatment and this advice to parents.

While the prophylactic work is being done, operators are instructed to talk to the children with reference to the importance of cleaning their teeth, the eating of proper foods and proper mastication. They are also frequently instructed in the proper use of the tooth brush.

School Lecture Work.

A school lecturer is employed for the purpose of giving educational stereopticon lectures to the children in the various schools and orphan asylums.

Since last February, the school lecturer has visited nearly all of the schools and orphan asylums, and has talked to over 42,000 children. These lectures consist of the usual lantern slide talks on Oral Hygiene, the care of the mouth and teeth, etc. We usually aim to have the lecture given just before our operattors are going to visit a school, as we find that it creates enthusiasm for the work that follows. The lectures are very popular and have created a wide interest in Oral Hygiene, not only among the children in the schools, but with the adult population as well.

I have tried to tell you our story as briefly and concisely as possible, and if there are any details which you desire or information which I may be able to give you, I shall be very glad to have you write to me at any time.

The work has met with a very hearty reception in Rochester, and it is a matter, of very great encouragement to all of us who are believers in the value of spreading the gospel of Oral Hygiene. The results so far accomplished have been most encouraging and gratifying, and in my opinion, the time is not far distant, when every enlightened community will see the necessity and value

of making the prophylactic treatment of children's teeth, a part of the school activities.

DISCUSSION.

Charles H. Oakman, Detroit, Mich.

I would like to ask Doctor Burkhart if that was 64,000. I think, Mr. Chairman, that the report which Doctor Burkhart gave in regard to the Rochester work is very gratifying. We who have been interested in Oral Hygiene work for a long time have been watching very carefully both Forsyth and Rochester Dental Infirmaries, and both are doing very good work. I think the time is not very far distant when more institutions will be endowed in this country. We know what some of the industrial concerns are doing in the way of Oral Hygiene, and we have reason to believe that in the next few years, the work will be greatly enhanced. We know that if a child is kept awake at night suffering from toothache, it disturbs the other members of the family who are employed, and consequently, the efficiency of the employee is effected to some degree at least, and the employer must necessarily be the loser from this inefficiency. In my lectures I take great pleasure in throwing on the screen pictures of the Forsyth Dental Infirmary. Doctor Burkhart told me that I could have pictures of the Rochester Dental Infirmary. It will be a pleasure for me to add these to my stereopticon lectures. I never tire of telling of the philanthropy of the founders of these two great institutions.

Albert E. Bonnell, Muskogee, Okla.: I would like to know if that work is done under the direction of licensed dentists. Also, are the assistants licensed?

George F. Burke, Detroit: I was interested in hearing Dr. Burkhart's statement that they had been able to popularize their lecture work. That is not true in some sections. I would like to ask if those lectures are all delivered by one person and are they given in the day-time or night-time, and are they illustrated? Are announcements made by the teachers or are notices sent home by the children to the parents that these lectures are to take place?

Charles H. Oakman, Detroit: Before Dr. Burkhart might leave I would ask if you have any medical or surgical nurses who have taken up mouth hygiene work, and if so, what course.

John P. Reece, Bloomington, Ill.: I find in our town there are a good many people who object to having their children's teeth examined. Do you have a law in Rochester to overcome that difficulty?

F. F. Whitcomb, Omaha, Nebr.

The City of Rochester certainly deserves much praise for its citizenship which must be possessed of a most generous public spirit and a keen interest in the health of its school children. With an appropriation of $20,000.00 per year to carry on the work of prophylaxis I feel sure that this city in a very few years will realize wonderful results. I only regret that many other cities in the United States have not such men as Dr. Burkhart to press the need of oral hygiene and secure the cooperation and financial assistance of the public, such as he and his associates have done.

May I state further that I most heartily approve of the school lecturer who carries on his work thru the public schools by the use of stereoptical views. There is not a member of the profession present who does not realize that the ultimate aim of this line of public health work is its educational value, furthermore, we agree from the pedagogical standpoint that we can best impress the minds of our young Americans by vitalizing our work—by producing real truths.

Dr. Burkhart describes in detail the equipment and we could not question

for an instant but that Rochester is in possession of the best obtainable, but if you will permit me, I will be glad to discuss briefly the method in which it is used.

As you have heard from Dr. Burkhart's description of the work in Rochester his so called "squad" has the equipment arranged so that it is easily moved. These trained Hygienists move from school to school in order to reach the children. I believe strongly in the professional man remaining in his office or in a central clinic. These children, who are to be our future citizens, must be educated to go to the professional man, not to expect him to bring his services to them.

With this comparison in mind I wish to describe to you the work as it is most successfully carried on thru a central dispensary, namely, The Omaha Free Dental Dispensary for Children.

This institution is absolutely a charitable institution financed by donations from the public spirited citizens of Omaha.

We were given fourteen hundred square feet of floor space in one of our most centrally located office buildings. This space has been divided in sections consisting of an office, a waiting room, one large operating room, an extracting room, a sterilizing and a supply room. The large sunny operating room is equipped with five complete operating units.

We feel that this large bright thoroly equipped, strictly sanitary room presents a faultless appearance and has a wonderful psychological effect on the children. I believe this is one very strong advantage over the dispensary in the school.

The school building is the abiding place of the child and in most cases it would be impossible to find a space which would present desirable conditions.

The question now arising is, if we have a centrally located dispensary how do we reach the children?

During the period of organization of our work, we realized that it was to be directly in the interest of the school children of our city and that from the standpoint of their health we could best reach them by a close cooperation with the staff of Public School Nurses. Fortunately, the department of Health Supervision in the public schools received our suggestions with the greatest enthusiasm and we at once proceeded with our plans.

The City of Omaha employs a staff of eighteen school nurses under the Board of Education. Arrangements were made for a course of lectures to be given in which these trained nurses would be given special instruction regarding examinations of the mouth, oral hygiene, etc.

Mouth inspection of all school children then became a most important part of the routine of the school nurse. After having inspected an entire school room of children, very courteous printed notifications signed by the school nurse are sent to the parents. Where there is much evidence that the children are not able to employ the services of a dentist the nurse goes to the home where, after financial investigation is made and the family found to be deserving of charity, the children are given entrance cards, bearing a condensed history and signature of parent and school nurse. Children are admitted to the dispensary only thru this routine procedure of the school nurse.

To avoid confusion of the daily routine of the dispensary work, three nurses are assigned each day and on this day they are responsible for the children from their schools. Unusual interest is displayed among the nurses in this work. Among the younger children groups are formed to go together and this is called a Dental Party. Never has one of these young guests refused an invitation.

Since our ultimate aim is to impress upon the children our slogan "Clean Teeth, Good Health" we have established educational lines in both the school room and the dispensary.

One of the main lines of teaching by the school nurse is the care of the teeth. Her main aim is this line is to do away with the old idea of the child that "to scrub the teeth" is a drudge, and to prove to him the necessity by making it a vital part of his young life—and a real pleasure. May I state here as a matter of comparison with the Rochester method—I believe Dr. Burkhart stated that twice each year literature was sent out and the lecturer made his rounds once a year—that children must get the lesson of "Clean Teeth, Good Health" by repeated lessons and demonstrations. This is made possible in our system, owing to the fact that most schools in the city are visited three times each week by the school nurse. She uses different interesting devices. Following is a general routine of procedure:—

Very little time is given to the nurse for teaching on the daily school program, therefore her talks must be short and well planned. Her first talk covers but a few minutes in giving a vivid description of teeth that are never cleaned. Lesson No. 2. Each child is asked to bring a picture from some magazine or book which tells something of clean teeth. Lesson No. 3. The pictures are discussed and posters made from the most attractive ones. Lesson No. 4. The nurse takes her brush and demonstrates how she cares for her teeth. By the time lesson five comes the children have a keen desire to *try it*. The children have been asked to bring their brushes and on this day they have their tooth brush party. Of course it is not to be expected that she gets 100% report on brushes at this first drill, but after repeated drills, even in the largely foreign schools she seldom fails to get a perfect report.

As one may imagine, many many children are taken to the dispensary before having had this routine in the schools, but this matters little as we realized the absolute necessity of educational work at every turn. Our office secretary has in her possession tooth brushes and small tubes of paste. She also has a button bearing a Lavender Cross with the letter C. T. G. H. signifying "Clean Teeth, Good Health."

Each child is given an individual health talk, by the office secretary, with the aim of impressing upon him the value of a clean mouth. If he has not a brush, and no means with which to purchase one he is presented with a brush and a tube of paste. He is then duty bound not to return to the dispensary for future treatment without a clean mouth.

When his work is completed and he has promised to keep his mouth in good condition he is presented with the Lavender Cross button.

If time permitted I would like to state some of the cases describing the real effect this work has had on the mental progress of the child, but I must not infringe. Without going into detail may I state that most interesting and surprising results have been noted. Thus we feel in our circuit of workers that the nurse needs the dispensary to handle these cases which are presented to her by the teacher who has perhaps named the child a "bad boy" or "dullard". The dispensary finds the reason, treats the case and returns him to the teacher as a *made over* product. In return the parent and teacher and child are ever grateful to the nurse and to the dispensary who make it possible for this line of health work to exist.

We attribute the happiness of our young patrons and the unlimited success of our institution to the fact that our work represents the public spirited ethical members of the profession. These volunteers are about one hundred in number who give one half day each

month to work at the dispensary that these kiddies might get the best possible care. Each one schedules his own time and is courteously reminded of his appointment a few days in advance, by the office secretary. This avoids any confusion in our daily routine.

In conclusion may I submit the report of our last year's work:—

ANNUAL REPORT OF OMAHA FREE DENTAL DISPENSARY FOR CHILDREN, JUNE 1ST, 1917-JUNE 1ST, 1918.

No. children examined	3,159
No. extractions (permanent teeth)	473
No. extractions (deciduous teeth)	4,740
No. prophylactic treatments	3,159
No. silver nitrate treatments	348
No. treatments (miscellaneous)	3,716
No. amalgam fillings	5,534
No. cement fillings	3,303
No. X-ray films	56
Total number operations	23,174
Average number operations per case	7

STATISTICS SUBMITTED BY DEPARTMENT OF HEALTH SUPERVISION UNDER BOARD OF EDUCATION.

SCHOOL YEAR, 1916-1917.

Approximate school enrollment.....25,000

87% found to need dental attention (examinations made by school nurses.)

7% received attention either thru free channels or family dentist.

SCHOOL YEAR, 1917-1918.

Approximate school enrollment.....30,000

82% found to need dental attention (examinations made by school nurses).

18% corrected cases reported.

During the summer eight school nurses who carry on the work in the hygiene centers give the following report:

Summer of 1917.

No. of children brought into the centers.....464

94% found to need dental attention.

10% reported corrected at close of summer.

W. G. Ebersole, Cleveland, Ohio.

I would be very glad to see the film which Dr. Whitcomb has. I had something to do with the production of a Mouth Hygiene film some years ago, and understand the value of a good film. I think it is up to this section to make some sort of an arrangement for an exhibit of his film.

The question was asked by a dentist whether they had any law in New York State that would permit them to make examinations in schools. That is the great stumbling block with a great many people doing mouth hygiene work. The man is approaching the thing from the wrong angle if he expects to get legislation. It is not necessary in Dr. Burkhart's town, or state because the people are interested in mouth hygiene. We have with us the next speaker who was responsible in a great measure for special action taken by the Health Commissioner of New York State which created that interest among the people of his state. The people of that state need no legislation to force submitting their children to examination in the schools, because they have come to know that it is not only in the interest of their children but of the general public health as well. New York State was the first to appoint dentists to its health staff. Detroit was the first city in the United States to place a dentist on its board of health and Dr. Oakman had the honor of being president of the board of health for one year. The State of Ohio was the first state in the union to have a dentist placed on its state board of health, Dr. H. C. Brown serving on the board for a number of years.

Sidney J. Rauh, Cincinnati, Ohio.—In this discussion nothing has been said about the treatment of children of pre-school age. Boston and Rochester are the only cities that have these facilities. Do they provide treatment for children of pre-school age?

In a recent inspection in a Cincinnati kindergarten, 58 children in one room, all five years of age, were examined, and of the 58—57 were found to require treatment! Would they come under the care of this dispensary?

William R. Davis, Flint, Michigan.—I think Dr. Oakman is responsible for calling on me. I have nothing to contribute. I came here to receive and not to contribute. I would say that our

community is getting ready to receive those who are interested in the subject of oral hygiene. Flint is an industrial city of about 100,000, and up to two years ago it did not have a full-time health officer. About that time it changed its health program somewhat and employed one of the very best health officers that could be employed. Some of the dentists are interested in taking up the subject of oral hygiene and they are ready to cooperate in every way to that end. We have a mayor, who, by the way, is one of the wealthiest men in the city and has retired from business, who has given much study to these municipal problems and he is ready to cooperate in that work. In fact, we were surprised when we began to take this up to find how ready the men were to take up the movement in the direction of oral hygiene. We have a Commercial Club which meets every Tuesday noon except during August. The average attendance is about 300. We had Dr. Oakman come to Flint in June and talk to these 300 men on the subject of oral hygiene and show some lantern slides. He received one of the best write-ups in the way of publicity that I have ever seen given to one of our Commerce Board speakers. Following his address there was a conference with the Mayor, School Board, Board of Health and Welfare Workers. The result was that the board of health in making the budget for next year voted to take on a full-time dentist, another full-time physician, and several full-time city nurses.

Charles H. Oakman: Dr. Davis' modesty prevented him saying too much about the Flint Commercial Club. It is one of the liveliest commercial clubs in existence. One and a half hours after the meeting was over these men in Flint who were interested had engaged a full-time dentist and two nurses. I know that Dr. Davis is so enthusiastic that next year he will have a good report to present.

Harvey J. Burkhart (Closing): In answer to Dr. Oakman's question, it is 74,000. There is a survey of the mouth of every child after the mouth is cleaned up. We have records by grades wherever the work is done. They are kept as a permanent record and will be kept as a permanent record for the purpose of comparison to show the value of the work and the improvement in the condition of the children's teeth.

You would probably be interested to know that we do no prophylactic work in the infirmary. It is all done in the schools. The only prophylactic work done in the dispensary is for the children under orthodontia treatment. We have now about 60 cases under orthodontia treatment. The teeth are cleaned before the bands are placed in position.

The question Dr. Bonnell asked is with reference to the employment of licensed dentists. I might say our plan has been subjected to change from time to time. Our work is entirely new. When the work was inaugurated the dispensary was not in operation, so there was no regularly employed operator. Under our law it is necessary for dental hygienist to work under the direction of licensed dentists, and so anticipating that there might be some trouble, we are making it a rule to see that there is no prophylactic work done in the public schools or other places except in charge of a licensed dentist, licensed under the state of New York, for the purpose of safe-guarding the institutions and also for the purpose of giving the lie to the statement that had been passed about several times that dental hygienists were being educated for the purpose of practising dentistry illegally. As I said a moment ago, we pay very great attention to that. A considerable part of the work was done by licensed dentists. That work was started in a very encouraging manner about the middle of last September. The infirmary was not opened until the middle of October.

There is a staff of about 20 or 25 licensed dentists who are placed in charge of the work for the purpose of seeing that it is properly done. So a great part of this work, I cannot tell you just how much, during the year was done by licensed men. The percentage done by dental hygienists perhaps may have been about one-third.

Not only was it a source of very great satisfaction to me to have them do this work, because I know they are more skillful than young women who have just entered the hygienist school, but also on account of the educational facilities which are afforded operators for observation, etc., and to give a young man just out of college the benefit of such experience, a larger experience than he could get in almost any other way, in observing the various conditions about the mouth, and also an excellent knowledge of the proper conduct of the particular business in which he is engaged. As you know, one of the great charges that is laid up against the dental profession is that they do not know anything about business and that they know very little about regulations and rules and follow them out very imperfectly. It is our aim and it has been our practice to hold these young men to as strict an accountability as it is possible to do. They have been quite as strict in their observation of the rules and have had to conform quite as strictly to them as do the military men to their rules. Of course, we have not the control over them that the military officers have, except the control to dismiss them when they do not do the work properly. We have been most careful and very particular to have work done so there will be very little criticism on the part of the dental profession and on the part of the public.

I think you will also be interested in this little story with regard to the reception of the work. Of course, you know in doing work of this kind and in coming in contact with so many educational authorities, teachers, principles, etc., that it would not be strange if there was considerable objection. In cleaning the teeth twice of approximately 35,000 children we had just one single objection. There was an objection on the part of a parent about the middle or latter part of April. The complaint came to the dispensary that the child's mouth was infected on account of the carelessness of one of the operators, but upon investigation and by checking back in that school it was found that the work was done by a licensed dentist. The work was carefully supervised by the operator in charge of the school and the principle of the school, a woman, who had been very much interested in oral hygiene and was most particular to be around all the time to see that there was no sloppy work done in the handling of the patients. It was found that this infection was not due to any carelessness on the part of the operator, but to the dirty hands of the child itself. There was just that one objection, so it does seem like a very remarkable record.

In answer to Dr. Burke's question, no statement was made regarding the first lecture because it was rather imperfectly done, but the lecture work since February has been carried on by the widow of the late Dr. William A. White, whom you all remember. The lectures consist of illustrated stereopticon lectures that are delivered in the day-time in the public schools and notice is usually given so that the parents may have an opportunity of coming and listening to these lectures. Where there is no larger assembly hall so all the school can be lectured to at the same time, they are taken by grades. In some of the larger schools there are probably six or seven lectures a day. The lectures consist of talks on oral hygiene and the necessity of caring for the mouth. We try to get just as practical slides as we can to interest the children. Remember this is a very practical thing and I think one of the very

essential things in starting this work of oral hygiene, namely, that the lecturer must not go over the head of the child. The lecture must be so plain and simple that the child can understand. The purpose is to work in a large series of slides that are interesting to the child and some funny ones occasionally. We have gone thru perhaps a thousand or fifteen hundred slides. Then we fit a lecture to the slides, a lecture that will take somewhere between 25 and 35 minutes, but the lecturer should have the child's interests all the time. This lecture work is very popular. I meet people on the street, those connected with the dispensary, directors of the board of education, principal of schools, and they say, "My child has come home and referred to the necessity of care of the teeth, "and they always mention the particular slides that interested them most and that really made an impression on their minds. For that reason we want to get all the slides possible that will illustrate this subject to the children below the ninth grade. If any of you have slides of interest, we will be very glad to have you send them to us.

In addition to the lectures in schools the school lecturer talks to mothers and health clubs in the various parts of the city. Then the operators connected with the dispensary and myself give talks before men's clubs and women's organizations. Our time has been considerably taken up by this work, but we have felt we have gained a very great deal in an educational way.

Of course there is a financial consideration which has been raised by the dentists and the inadvisability of doing this work in the public schools. Charges have been made that it is going to interfere with the work of the dentists and it is going to take money out of their pockets. Instead of losing business since this work has been brought into view, his work has been increased because parents have been informed of the necessity of keeping the child's mouth in proper shape and they go to the family dentist.

In answer to Dr. Oakman's question, we do have regular medical nurses take this course. The law states that the course of instruction must be one year in oral hygiene. There has been a modification. Up to this time there was just one course. Now we are going to have a short course. A medical nurse regularly graduated is permitted to take what is known as the short course. One course begins in September and is finished in February and another start in February and finishes in June. I would also say that concession has been made to young women who have been employed for three or four years in an ethical dental office. We do not take nurses who come from advertising offices. My opinion is that after this year we will not be permitted to have this short course.

In answer to Dr. Reese's question regarding a law to enforce parents to permit their children to being examined in school, no, there is no law or regulation that will permit us to examine a child's mouth. I think the Board of Health will permit us to examine a child's mouth if we think the child is infected with a contagious condition, but there is no law that will require the parents to have their child's teeth cleaned in schools.

In answer to Dr. Rauh's question, our aim in Rochester is going to be to educate the mothers to bring the children to the dispensary as soon as the first teeth appear. If so, we are going to carry them along until they are 16 years of age, when we will graduate them from the dispensary. We have been treating a number of children of pre-school age. There are a great many of two or two and a half years, and we are endeavoring to have the parents understand that they may bring their children to the dispensary as soon as their first teeth appear.

THE DEVELOPMENT OF PERIODONTIA.

By Nelville S. Hoff, D.D.S., Ann Arbor, Mich.

(Read before the National Dental Association at Its Twenty-second Annual Session, Chicago, Ill., August 5-9, 1918.)

WE EXPERIENCE some difficulties in attempting to give in a brief statement the history of a subject having so many relations as are involved in anything like a comprehensive review of the rescue and prophylactic treatment of the teeth and their immediate environment.

We possess no authentic data as to a systematic effort on the part of primitive people to preserve the health of their teeth. As a matter of fact we are not sure these people were seriously afflicted with dental diseases. We have some historic records of Chinese, Indian and Egyptian means of treating their teeth, but in most cases the idea seems to have been to use these agencies primarily for cosmetic reasons rather than for hygienic results. The Chinese polished their teeth and colored them for show; the islanders filed and stained theirs for similar reasons; the eastern warriors sometimes mutilated their teeth to make them seem more ferocious; Indians devoted much time to polishing their teeth as a part of their religious devotions.

In the earlier civilizations we find suggestions of therapeutic practices of a crude and empirical character. There was nowhere a scientific or rational process with prophylactic or therapeutic ends in view. All these endeavors were practiced entirely for esthetic reasons or for the gratification of individual desires.

Hippocrates the acknowledged author of the earliest intelligent scientific medical literature was the first to write of mouth washes and dentifrices used for therapeutic purposes about 450 years B. C.

Pliny and Galen the early Roman historian and doctor of the first century wrote rather extensively of the practice of using mouth washes and dentifrices by the better classes of the people of that period. The use of these remedies seems to have had an intelligent conception of their value as prophylactic and therapeutic agents.

Pliny records a formula for a dentifrice which consisted of burned egg shell pulverized and mixed with honey for beautifying the teeth. Galen describes rather accurately suppurating gums and prescribes an astringent mouth lotion to induce healing. Abulcasis a celebrated Spanish physician and surgeon, about 1100 A.D. was the first to advocate the removal of deposits from tooth surfaces by steel instruments which he designed especially for this purpose. He described in detail the technic of the operation, and may be given the credit for introducing an operative procedure for the cure of pyorrhea alveolaris.

Guy de Chauliac a Frenchman about 1350 A.D. published in his great surgical work a formula for a very logical dentifrice. It contained powdered cuttle bone, sea shells, pumice stone, burnt stag horn, nitre, alum, rock salt and dried herbs and roots. He also suggested a liquid mouth wash containing salt, sal am-

moniac and sweetened alum, which was to be rubbed on the gums with a *scarlet* cloth.

Fauchard, in 1723 published the first book devoted entirely to dentistry rather than medicine or surgery. In his book he advocated the thoro removal of all deposits first and then the application of a dental lotion of his own devising, which contained twelve different ingredients and which took nearly three weeks to make. He instructed his patients to apply the lotion with small sponges, rubbing the teeth up and down, inside and outside the arches, at regular intervals each day. He says the sponge is preferable to the *horsehair bristle brush* or the wooden sticks for applying the remedy. This statement would seem to indicate that brushes and sticks were the customary means of applying dentrifices at that date. He also gives a formula for a tooth paste in this book. Fauchard is also responsible for the name "pyorrhea" as applied to suppuration of the peridental structures.

In America we have no very definite early data of means used to treat peridental diseases and no literature describing the various manifestations of this disease, obviously because we had no literary men or means of recording matters of this kind. Josiah Flagg, who practiced in Boston, advertised in a Boston paper to supply the public with suitable dentifrices, tooth brushes, and "Chew Sticks" for cleansing and whitening the teeth. He volunteered the statement that their faithful use would prevent diseases of the teeth and gums. Probably the most definite date when systematic surgical treatment was publicly announced to and by the profession, was June 11, 1867. On that day Dr J. M. Riggs of Hartford, Conn., announced his surgical treatment for the cure of pyorrhea alveolaris, in a paper and clinic given before the Connecticut State Dental Society. While this clinic did not at once establish a successful treatment for periodontitis it called attention so strongly to the fact that this disease was curable that the way was opened for experimentation by others. The radical and painful character of the operation as made by Dr. Riggs was a hindrance to its acceptance by the profession. October 19, 1898, Dr. D. D. Smith of Philadelphia read before the Northeastern Dental Society in Hartford, Conn., a paper entitled "*Prophylaxis in Dentistry.*" This paper was published in *The International Dental Journal* of January 1899, page 16-23. Subsequently Dr. Smith instituted a vigorous campaign for what he termed "Oral Prophylaxis", which resulted in the greatest movement the profession records for better oral hygiene.

The work of Dr. Riggs undoutedly stimulated the profession to undertake more careful treatment of the teeth and gums but his treatment was so severe that little progress developed in his time. It however caused the profession to study the problem and to devise more effective instruments for the surgical treatment. The text books of the time contained little information as to a method of treatment, or description of the pathologic conditions. Taft's Operative Dentistry, the accepted text book of the time, published in 1877, on page 25 makes the following brief statement as to treatment. "When the thick incrustations have been removed, the tooth surfaces should be gently scraped to clean off all remaining deposits, afterwards the surfaces of the teeth must be carefully polished with fine pumice and then carefully burnished, as the deposits often extend beneath the free gum margins. Much care should be used to remove all deposits and leave the tooth surfaces smooth." This statement may seem to cover the subject sufficiently, but its brevity and lack of supplemental technical instruction in detail lacked the

force to induce students and practitioners to put it into practice. In fact it was only when Dr. D. D. Smith put his indomitable purpose into a most strenuous campaign that the profession became sufficiently interested to attempt to practice a treatment which has substantiated the claim that peridontoclasia, in all stages, is a curable as well as a preventable disease, when proper and adequate surgical and prophylaxis treatment is administered, and a reasonable regimen of oral sanitation is installed.

It is probably correct to say that had Dr. Riggs instituted professional as well as individual prophylaxis for his patients he would have demonstrated to the profession much earlier the possibility of successful treatment, and he would have had a larger following of his methods, radical and painful tho they were. It is not possible for us to give credit to all the men who have contributed in a technical or scientific way to the present status of this subject; but we may say that after much discussion, experimentation and endeavors to utilize various medicinal agencies, the profession has reached a fundamental basis for successfully treating one of the most universal diseases which has afflicted mankind, and incidentally started a movement which we believe will ultimately place all dental diseases under preventive control.

We do not yet fully realize what a tremendous and far reaching piece of work was done for humanity when Dr. W. D. Miller established the basis for a practicable understanding of the nature of dental diseases. Miller's discovery of the true cause of dental caries naturally suggested to him that the cure must necessarily be found in the line of germicides and antiseptics; just as the medical profession a few years ago believed that as ameba were found in suppurative conditions of the gums that emetine would surely cure this disease, because it is the acknowledged specific. Miller was first to discover to his regret that it was impracticable to use germicidal remedies for the prevention or arrest of caries because of the peculiar environment of the teeth, and along with many others he started an exhaustive research to determine the practicability of so modifying the secretions in the oral cavity that caries of the teeth would not so readily occur. Because of the intricate complications involved in this endeavor he never became enthusiastic as to practicable results. And the last three years of his active life were devoted to what seemed to him to be a more logical method of obtaining immunity to disease of the dental tissues.

It should be known also that Miller was moved to undertake this last research because of the fact that his sympathies were so strongly enlisted in an endeavor to do something to relieve the poor children where he lived of a disease more prevalent than any other and which they were of themselves wholly unable to avail themselves of the usual remedial agencies. He believed that some form of practicable prophylaxis that could be placed in the hands of all young children would meet this problem better than anything that had as yet been tried. Hence he undertook an exhaustive study of the problem of the efficiency of the various agencies that had been used or might be employed in a mouth toilet that was within the means of the poorest child. His untimely death, however, put an end to his plans; the work, however, was not stopped, in fact it has, we believe, developed into one of the most promising efforts the world has yet seen in the direction of bettering public health.

The propaganda carried out by the Oral Hygiene Committee of the National Dental Society a few years ago with so

much enthusiasm succeeded in firmly establishing in the minds of the public the value of human teeth and in creating such a strong sentiment for better tooth health that there is scarcely a community of average size where some form of public effort is not being made to instruct children as to the value of their teeth, and where some means of treatment is not provided for such as can not afford professional treatment. In many cases this agitation has resulted in substantial financial expenditures by school boards and health authorities, and two great institutions have been erected at great cost to provide inexpensive treatment for poor children, and also to train special workers for the cause of preventive dentistry.

The practice of Oral Prophylaxis, as advocated by Dr. Smith incidentally did much more than to convince the profession that suppurative peridental diseases were curable; it also demonstrated that by keeping the exposed tooth surfaces clean it was practicable to prevent initial caries or to check its progress. In this way, a new impetus was given to practicable cleanliness of the exposed surfaces of teeth which developed the treatment we have called oral prophylaxis.

This treatment has developed so extensively as to make demands on the time of the dentist which he is unable to meet, especially as it created a demand for a new and special technic. This demand we have tried to meet by training dentists to specialize in this department alone, but the demand has far exceeded the available supply of dental graduates and after a long discussion, which we can not here record, an effort is being made in several States to train a class of practitioners which we have named *"Dental Hygienists"* who are to undertake a part of this work, practicing under the direct supervision of registered dentists. The exact field of work is to be the prophylaxis of teeth not affected with disease. In this way a large amount of preventive service will be available to school children, people in institutions, and those who can not afford the services of regular dentists.

The work is now well started in four States, and the outcome is anxiously being watched by the profession. If it shall prove a successful method of providing prevention it will undoubtedly be adopted as a helpful measure in other states. It is not expected that the Dental Hygienist will attempt the surgical treatment of diseased teeth and their immediate environment, but, as we have discovered that no surgical treatment can promise permanent results that is not supplemented by continued prophylactic supervision, this should give the Dental Hygienist a place of exceeding usefulness and importance in all ministerial efforts in the prevention of active caries and consequential periodontal affections. We are, perhaps, with this brief and necessarily incomplete resume of our subject prepared to make some statement of the present standing of Oral Prophylaxis, or dental hygiene, that shall predict its future, or at least enable us to speculate as to its artistic and scientific attainments.

By Surgical and other therapeutic agencies we have demonstrated that it is practicable to redeem from apparently hopeless inefficiency teeth whose supporting structures are so badly diseased that they are generally condemned by the dentist to extraction. We have also demonstrated that it is practicable to so completely eradicate the disease and restore the supporting tissues about the teeth to such a condition of health as to provide acceptable functional activity. In doing this we have materially assisted in reestablishing a measure of general systemic health that the medical practi-

tioner very often has failed to accomplish because he has ignored diseases of the oral cavity, as causative factors, in his diagnosis and therapeutics. He has failed to take into account the importance of tooth health in its physiological relations, as well as the dental pathologic conditions as active sources of systemic infection.

What is of more fundamental importance is the fact that we have demonstrated by the institution of a well conceived scheme of dental and oral prophylaxis the practicability of preventing dental caries in the teeth of the young as well as the adult who are as yet unaffected. By accomplishing these fundamental objectives we have prepared the way for working out a practicable scheme of oral hygiene that should change radically the ideals of dental practice, which in the past and even today consist almost wholly of efforts to rescue humanity from the results of diseased oral structures, and to supply artificial organs of mastications and speech. The ideals which at present seem to actuate the specialists in the field of periodontology are to rescue and make as serviceable as possible the diseased and mutilated dental organs of mastication; to eradicate from the mouth all possible sources of systemic infection; and to prevent as far as practicable the initiation and progress of active dental caries and peridental disease; believing that insofar as this is accomplished the ideal of preventive dentistry, which is oral hygiene, will be attained.

This is we believe a fair statement of the working scheme of the average prophylaxis practitioner who is devoting his whole time to this one line of effort. It is true that some are so perfunctory in their efforts as never to have idealized their specialty at all; and undoubtedly there are those who have enlarged and clarified visions of even greater possibilities; and possibly some of us dream dreams of a millenial period where perfection in dentition and preventive dentistry shall be the customary and not the rarely occasional condition of the oral cavity.

If our highest conception should ever be realized it will surely be only after great and concentrated effort with some such worthy aim for its goal. And if we are dreamless and contended with the practicable, which we all confess is not wholly satisfactory, how can we expect to realize the more perfect ideals, or how can we expect that spiritual development which shall bring us the inspiration of a clearer view of greater possible attainments?

Without posing as a seer with supernatural vision, or as one possessing superior knowledge of the subjected, I shall risk the chance of being classed as a dreamer of unrealities which are too idealistic for practicable consideration; and present some notions which to me seem practicable of attainment and to invite you to make their serious consideration matters worth while keeping clearly before you in your practical efforts to advance the cause of rescue and preventive dentistry with more speed than seems possible in any other branch of our professional practice.

It seems to me that our aim primarily should be to so encourage or permit the forces of development to operate, that the typically normal in development of all associated dental organs shall obtain in the growth of the human body. This may possibly involve some form of prenatal interference; it certainly will demand very early and continued supervision of child life from the eruption of the first deciduous tooth onward to at least the time when the permanent second molars take their proper places and assume their functions in the norm-

ally completed dental arches, and with accurately occluding teeth.

This ideal assumes that the facial bones have also developed to the normal and that all associated organs and tissues are in a healthy state for physiological functioning. Necessarily this may involve more or less artificial interference during the developmental period, and should be accompanied by a complete system of professional prophylaxis and personal hygiene. The idea being to establish at the earliest possible period an habitual regime of mouth hygiene of approved character for every individual. This may involve more or less technical treatment because of unavoidable accidents or unpreventable disease attacks during the formative periods. The fundamental idea being that so far as may be a perfect masticating machine should be developed along with the establishment of wholesome sanitary habits, at an early date which should prolong the natural period of immunity to disease of the dental structures well into mature life. This will assure normal function and freedom from disturbance of development during the formative period of life.

It may make it easier to see this problem more clearly if we should classify it subjectively under the following headings:

1. Present status of our knowledge and art.
2. Efforts to attain typically normal development.
3. Medical cooperation.
4. The problem of nourishment.
5. General conclusions.

Present Status.

Our first factor probably needs little consideration in this audience as its scientific and technical bearings are well known. For conservative reasons we shall be wise to hold on to all the knowledge we have accumulated and likewise employ all the technical skill we possess until we shall have good cause to modify our statements or make changes in technical procedures. Unless we handicap our visions by routine methods of a technical character, or remain satisfied with our present knowledge, we shall need to incorporate new principles and practices as we develop in science and art. We shall need a truly scientific attitude of mind to realize soon our dreams. Standards based on experience are most valuable assets, but their chief function should be to enable us to achieve the ideals that develop in our endeavors to attain perfection. We believe we have established some fundamental facts out of our experience in this work that we should hold tenaciously until we have cause to modify our views. So far as we can determine ancient people believed their teeth should not decay, and Dr. Smith in his first paper on Oral Prophylaxis asks whether dental caries is preventable. He believed it was and on that fact he established his theory and practice of preventive dentistry which most of us have confirmed not only theoretically but in actual practice. We should from this single conviction be able to construct a working theory that shall make potential the ideals which actuated such men as Miller and Smith and enabled them to consecrate their lives to the realization of so great a benefit to humanity as the prevention of dental diseases.

Normal Development.

We have yet to learn some things about causes which operate to produce the abnormal and defective in dental development. We of course need to learn newer and better methods of encouraging the typically normal in development. The Etiology of maldevelopment of the teeth and jaws has

been studied for many years with care, and we think we have fairly accurate knowledge of many causes which operate to produce mal-formations of the dental arches and their teeth. These studies have been made largely from the viewpoint of the practical orthodontist rather than as matters of scientific relations to the greater field of general systemic health. At least they have not been carefully studied in relation to the subject of oral hygiene and other causative factors in systemic diseases. The problem is a profound one and needs the most accurate study and will require the time and skill of our ablest research scholars. We should know the actual conditions in health in order that we may understand the course of disease processes, else our work is liable to be characterized by faulty clinical experiences.

Most of us believe from our clinical observations that malposed or malformed teeth are the definite cause of peridental as well as tooth diseases, in fact we have so generally accepted this theory that we have not been curious to look farther for either active or remote causes. We rest satisfied for instance with our knowledge of tooth structures and its peridental environment both anatomically and pathologically. We likewise believe the cause of dental caries has been so carefully worked out and its pathologic control made so simple that it needs little further serious consideration. We do not dogmatise with the same assurance about the nature of peridental diseases. Do we even know the minute anatomy of the peridental membrane or its physiologic functions? It is true that the diseases which affect the peridental structures generally occur so late in life that they have little relations to the problems of preventive dentistry in the formative periods, but we must recognize their influences in the adult and degenerating periods when periodontal affections are so prevalent and difficult to control.

The results of active or progressive tooth caries are subject to control by our perfected operative procedure and in large measure we are able to control incipient and even progressive periodontal disease if treatment can be applied at the favorable periods of its development. Our ideals should, however, aim at the prevention of these affections at such periodic occasions as shall be most affective. When we can demonstrate that the deciduous teeth need never decay, or be lost to function, until their successors are ready to replace them in function; and when we can by prophylactic interference assure normal and typical development of the teeth and their associated structure, we shall have accomplished the first and greatest step in complete oral hygiene and prepared our patients for better general systemic hygiene.

Such an attainment should certainly appeal to our professional patriotism, and we believe it is practically obtainable. It will be a very slow process of development if we are content to wait until we shall have accomplished this by a higher order of technical and therapeutic skill. We must first get the ideal and cultivate our art on a natural and scientific basis.

Medical Cooperation.

We also shall need to give the entire subject a broader consideration and enlist the cooperation of the medical profession, particularly those specialists who practice in our contiguous field and such other parts of the system as may be physiologically or pathologically related.

The rhinologists and medical internists should be able to render incalculable service by cooperating in practical treatment and in studying the problem in a scientific way, that both professions shall not only render more efficient ser-

vice but become more acute observers of all the phenomena involved.

Medical literature until recent years has given but slight notice to dental diseases and even now its concern seems somewhat desultory and trivial. As a matter of fact medicine has not given the attention to development of the body that it deserves as a general prophylaxis measure, and it may be our privilege to demonstrate the necessity for a more careful and mutual study of this problem. It would seem that the present is an opportune time to secure a closer relation with medical scientists because of the events which have led up to a closer study of diseases of the teeth and jaws as sources of serious and obscure systemic diseases.

We must show our medical associates that the mouth is one of the predominating factors in the proper development of the body, and that no effort made by them to assist us in providing a proper development during the earlier formative periods of the essential organs of nutrition, such as the mouth and nose will be without adequate compensation, in better developed tissues and organs in other parts of the body.

Next to the mouth the nose is the most important avenue thru which the tissues of the body are nourished and it is therefore highly essential that it be kept healthy during the developing period. By this means the air that is passed to the lungs should be as free as possible from infectious influences and be properly prepared for easy assimilation. The functions of the nose are so frequently interrupted by serious malformations and diseased conditions of the mucous membranes that the air passed over them to the lungs becomes a source of irritation and a carrier of disease influences, rather than fulfilling its nourishing function.

The Orthodontists are of the opinion that malformation of the nasal tract and diseased conditions of its tissues prevent adequate development of the facial bones. Such conditions are recognized factors in retarded mental development, and demand our close study that adequate prophylactic measures may be instituted at the right time to insure prevention rather than be forced later to adopt corrective measures.

The medical internist should render valuable service in directing treatment for the conservation of oral sanitation during accidental illness in the periods where tooth deformities are liable to occur from interrupted development of the alveolar process and in deficient calcification of the teeth.

A most important function of the medical advisor will be to direct scientific feeding, clothing, exercising and the living environment of children that more perfect physical development shall result as a protection against disease and that less corrective measures shall be needed.

By such means a stronger resistance to disease will be developed, a better development of the dental organs secured, and consequently a more efficient functioning of all organs be attained. With a completed normal dentition and intelligent information as to hygienic habits the child should suffer no handicap in securing food of proper quality for good health. With the nasal tract also normal in form and its various glands and air cells free from disease, the child should secure the proper quantity and quality of good air for sustenance and for growth and will be fortified accordingly against dangerous disease influences. This brief outline only suggests the possibilities of medical and dental cooperation in attaining the ideals of preventive medicine and dentistry.

Nourishment.

We shall need also to study the food problem more adequately than we have. This means not only that we shall have

more definite knowledge of diet, as related to food values, but we must know how to adapt food to the particular individual who may not at all ages or under all conditions of health react favorably under a formal dietary that may be ideally balanced for the average healthy child, and yet not be the best diet for a perverted systemic condition which does not thrive with the usual food rations. Here again the medical man has a most important function which the usual student of diet from the chemical or physiological viewpoint, could scarcely handle adequately. There is today and has been for many years a great tendency to study the food problem in what might be called an academic manner. This method of course is necessary but it is so formal and dogmatic that it too often fails to recognize conditions that are continually being met and recognized by the clinical practitioner. We have also to contend with the food specialists,—who are liable to be hobbyists, or over zealous and narrow visioned, tho well meaning in their intentions. The problem of nourishment for the best results in development should be kept under close observation by both the medical and dental advisers during the early periods of life. We should know this problem academically of course, but we can serve our patients only when we can have the child under the closest practicable clinical surveillance. This implies more careful and more frequent inspection by both dentists and physician in order that any accidental aberrations may be corrected before injury results. If a child is not increasing in weight normally there must be a reason which should be found out and corrected, likewise if there should appear any adverse local manifestations the cause must be discovered and proper treatment instituted *at once,* not after the deformity or disease has matured.

Then there is the problem of the proper use of the teeth in functioning. The same rules for masticating food may not apply to all children or to any child at all periods of time or for all oral conditions. The subject of sanitation of the oral and nasal cavities is not a subject that we can dogmatise about at present. We don't know apparently how or when to brush or clean the child's teeth, or if it should be done at all. No more do we know how to keep the nasal tracts free from detrimental influences. Shall we teach the child to brush his teeth with abrasive dentifrices; or to chew gum? Shall we teach him to blow his nose; or let him snuffle? The oral and nasal tissues both require careful sanitation as we know, and they also require proper and adequate exercise to assure normal function and adequate resistance to disease influences.

The salivary and nasal secretions are very unstable but also most important functional influences. Have we studied them from the standpoint of immunity to disease? Perverted secretions may respond to local treatment temporarily but many times the exciting cause is more profoundly located and the medical practitioner should be competent to advise proper treatment.

Conclusions.

When we attempt to make a comprehensive survey of our comparatively small area of influence we are met with the fact that the human system is an integer with very complex relations; and when complicated with abnormal influences its harmony of function is liable to most perplexing phenomena. Like a fine watch, when in perfect order it is dependable, but the least injury to any of its parts accordingly depreciates its reliability. We may never secure by all our skill and science a perfect development of the human body, as we do in the construction of a perfect machine, but fortunately nature has internal

sources of repair and protection which take care of slight and incipient defections. We can only depend on this vital repair force, however, to the limit of the physical endurance. This makes clear the field of study and practice of our art. We must stand at the portals of entrance to the body and protect by artificial means when necessary and practicable the entire body from injury. This we have done in considerable measure, but we should go a step farther and learn nature's laws and methods of developing the perfect machine and cooperate to the best of our ability in creating the strongest possible vital resistance against all unsanitary influences. If we could learn from the breeders of fine stock, or the scientific horticulturists some of the secrets of their arts we might get some suggestions that would stimulate our imaginations to undertake some better efforts in the line of better dental development than we have ever thought necessary, or practicable.

We must in every possible way encourage all well directed efforts to create a sentiment for better oral hygiene. There are bound to be fads in this undertaking as in every other good cause. We should carefully distinguish the *scientific and true* from the erroneous and harmful or inefficient method of the charlatan or unlearned. This means a closer study by the profession, and the encouragement of research; special instruction in our colleges and public institutions; dentists who are especially equipped to render a better type of service than the average practitioner of the present time; and lastly a more universal recognition by dentists of the possibilities of preventive dentistry as a greater good than rescue or repair efforts. This is a large undertaking indeed, but the objective is worthy of all the sacrifice and endeavor that we can put into its successful achievement. Its accomplishment should do more to hasten the development of the super-man than any other effort in this direction that is now being seriously considered. If the project seems large and demands more time for its solution we need not hesitate to undertake that which seems the more promising at once, and strive for more light and higher attainments in the future. With our aims clearly defined it can not be long before we shall make substantial progress in acquiring definite knowledge and in formulating proper methods of practice. It is this sort of effort that will compel the admiration of the world and benefit humanity to an extent we can not hope for by all our past inadequate service. It should place our profession on a better basis for medical and scientific recognition than we now have any reasonable expectations of securing. Is this not an ideal purpose and one that should claim our loyal devotion? And does it not seem to be the next and logical step in the development of our associated specialties?

Discussion.

Jules J. Sarrazin, New Orleans, La.

What I have heard of Dr. Hoff's paper makes me feel a keen regret that I did not hear it all. The paper is most excellent and worthy. One point in particular is that Dr. Hoff seems to adopt the pretty general idea that malposition of teeth will cause gingival disease. To my mind malposition of teeth is a predisposing, but not the determining cause of pyorrhea. The determining cause whether teeth be normally arched or irregular remains, the infective films retained at teeth necks in contact with the gingiva, but malposition is responsible for accumulation of infective material, while crowded roots lack sufficient blood circulation between them, thus lowering resistance, and thus malposition predisposes to disease, because infective causes intensify while resistance lessens; but

the true determining cause is always the germs and the toxins derived from plaques, whether teeth be regular or not.

Since efforts must therefore be directed to breaking up infectious films, and so doing approximately is both more difficult and more necessary, the home use of waxed silk tape, already charged with a smooth abrasive powder, must be directed, with proper technic, not only to children but to adults also.

Another idea which might be added to those brought out by Dr. Hoff, is that medical internists constantly seem to forget that the toxins in the mouth do aggravate the very diseased conditions that they are fighting. If we could so present the facts to medical internists that they would attach more importance to mouth infection, I think we would be doing a lot of good. This is a matter that I never fail to impress upon my medical friends as strongly as I can, that the failure to maintain prophylactic mouth conditions during illness is one of the strongest factors in preventing speedy recovery, and when they become well convinced of that fact, those who are concerned with the training of nurses will teach them to protect their patients from the toxins derived from the mouth, in order to relieve leukocytes of that much additional destructive effort, and leave them freer to conquer other micro-organisms.

S. J. Rauh, Cincinnati, Ohio.

The remarks of the last speaker presents a fact that should be brought before physicians. If the dentist is to come in contact with the physician he must do so thru the usual channels. We must work in the hospitals, many of which now have dental departments. For the first time this past winter a course of lectures was delivered in the Jewish Hospital in Cincinnati to the nurses. A dental intern is employed there under the active supervision of a dental staff, bringing the close association which Dr. Hoff suggested. The hospital is an excellent introductory means for reaching the children, as we begin in the obstetrical department. In the prenatal care of mothers excellent work can be done; for the mothers in the public wards are there for several weeks, or at least several days, before the birth of the child and for several weeks afterwards, and the training of the ignorant is done in the hospitals. If we are to make a step forward as dentists we shall have to make an effort to install a special dental department in all hospitals.

At the meeting of the Peridontists which took place here last week the question of standardizing brushes was considered. There is no more important subject than teaching definite methods of tooth-brushing. If we teach different methods the public will lose confidence in us. It is high time that we lose our tooth-brushing hobbies—we all have them!—and when we understand one another we shall probably find that we are not so far apart after all. Possibly a most important point would be to standardize the tooth-brushing methods.

H J. Leonard, Minneapolis, Minn.

One point which Doctor Hoff brought up I think should be emphasized to the orthodontists and periodontists, and that is the matter of diet and masticating the food. The matter of taking up a diet for children that will properly develop the jaws so that artificial dentures will not be necessary is one of the most important things this body could study. It is important not only with the orthodontists, but in regard to adults with the periodontists. There is very little given in the literature on that subject and Doctor Hoff's is practically the only reference that has been made to it here. It seems to me that subject should be

thrashed out very thoroly by some of our essayists in the future.

N. S. Hoff, Ann Arbor, Mich. (Closing): I have very little to add. I believe most earnestly in these principles—I have reached the point where I have ideals. You know young men dream dreams and old men see visions and I have a vision that when this great cycle of evolution comes around, we are going to have physically perfect men and women in this world instead of a lot of cripples that have to be helped to hobble along. My idea in writing this paper was to present this ideal, not as something that is attainable right now—it may be a million years before it can be brought about, but let us start out now. If we do not have an ideal before us it will make the cycle so much larger and we will make many mistakes and have to go back on the trip so often—like the detours in automobile trips where we get off the right road and have to get back. Whether it is a practicable ideal or not does not matter so much as long as it is the true one. If we feel that we can erect an ideal of something that agrees with what nature ought to be, why not keep it before us and have it as our motto? We have a saying that we should aim high in order that we may hit somewhere, but we prefer to aim straight, right at the bull's eye. As an idealist I feel that I should like to aim high and straight also. I believe the Almighty meant us to be perfect. He made a perfect man in the first place and we have degenerated. If we believe this why should we be attempting to cure malocclusion of the teeth, or why should there be a Society of Orthodontists; or periodontists, or of operative dentistry, or a Section of Prosthetic Dentistry and Crown and Bridge-work? They are all helpful agents of course and we have to have them at present, but why not aim to secure the perfect being? Like the stock raiser in Kentucky who gets the best stock, and the best food and the best help, and so develops the best race horse that ever lived why should we not develop the best race of people and have it come sooner than the millenium?

The idea of taking up this matter with the very small children to me is the logical starting point. If we can take these small children, before they have any teeth, or soon after they begin to erupt the first dentition and give them proper attention of a prophylactic character, so that we shall retain all those teeth in the jaw in the right relations until they are physiologically replaced by the second dentition, wouldn't that be a whole lot better thing than to have to be making crowns and bridges and treating root-canals and all that sort of thing? I have often wished I could take a lot of children and have them grow up naturally and normally just by teaching them what to do and how to live, so that they would grow up naturally instead of having to apply artificial means of correcting disease results thruout their entire lives.

METALLOGRAPHIC PHENOMENA OBSERVED IN AMALGAMS.

By Arthur W. Gray, Ph.D., Milford, Del.

(Transactions of the American Institute of Mining Engineers, Milwaukee Meeting, October, 1918.)

(Concluded from June issue.)

II. DIMENSIONAL CHANGES DURING THE HARDENING OF AN AMALGAM.

I must now turn to the consideration of those highly interesting and important volume changes that take place during the hardening process, changes that for lack of a better term I shall call "reaction expansions."[14]

11. Black Amalgam Micrometer.

The instrument, commonly known as the Black amalgam micrometer, shown in Figure 21, is essentially a form of spherometer for measuring movements in the free surface of an amalgam filling packed into a cavity.[15] This cavity is bored into one face of a round steel block, called a Wedelstaedt test tube. In the foreground of the picture can be seen a number of these which contain fillings, the tube in the upper right-hand corner of the group being empty. The black dots in the centers of the fillings are thin steel disks embedded in the amalgam while still soft, in order to prevent the measuring contact of the micrometer from sinking in. One of the test tubes is shown as placed in the instrument.

From the standpoint of the professional metrologist, the design of the Black micrometer is interesting as an example of accuracy in some parts, combined with abundant opportunity for serious errors, both systematic and accidental—errors which neither Black nor his followers seem to have suspected. While the dial under the pointer of the instrument is graduated in divisions corresponding to 0.0001-in. change in elevation of the amalgam surface, and readings are commonly expressed to one-quarter of this unit, the results cannot be relied upon to any such extent. I have nowhere been able to find the slightest indication that any of the users of amalgam micrometers ever thought to calibrate his instrument. The only check that seems to have been applied consisted in examining the filling margins with a binocular microscope, which, of course, would reveal nothing until the contraction or the expansion was great enough to tear the amalgam away from the cavity walls.

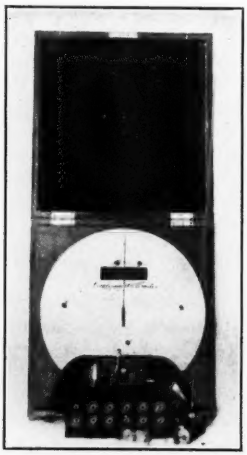
While the design of the Black amalgam micrometer is such as to render it unreliable for measurements requiring high accuracy, that of the Wedelstaedt test tubes is still more unsuitable. What is measured by the micrometer is neither linear nor volumetric expansion; it might appropriately be called heaped-measure

[14]Changes in microstructure continue for a long time after the amalgam is packed into the tooth, and these changes bring about not only rapid increase of strength and hardness but also dimensional changes, which, however, have nothing to do with the ordinary thermal expansion that follows change of temperature. They are accompaniments of the internal readjustments that take place, even at constant temperature, and may properly be called "reaction expansions," using the term in the algebraic sense to include both expansion and contraction. During hardening an amalgam may either expand or contract. More often, it moves first one way, then the other. It is not intended that the use of the term shall imply that the phenomenon is regarded as caused by a purely chemical reaction. The term is used for convenience to cover all dimensional changes that occur during hardening at constant temperature, whatever may be the nature of the internal processes that bring them about.

[15]Dental Cosmos, Vol. 37, P. 637 ff; 1895.

expansion. Even when a contraction is indicated, the movement of the filling is not a simple linear displacement until the amalgam has become completely free from the constraints imposed upon it by the walls of the cavity. The only reliable procedure for accurate measurements of expansions—whether thermal or reaction—is to employ a method which leaves the specimen perfectly free to change its dimensions in the direction of the displacements under examination.

Figure 21.



Black amalgam micrometer with group of Wedelstaedt test tubes in foreground.

The combination of Black micrometer and Wedelstaedt test tubes gives opportunity for still other uncertainties. A slight tipping or loosening of the little disk against which the measuring point presses has been known to give totally misleading readings. The pressure exerted by this contact point is far too great. The readings obtained depend too much upon the way the instrument is manipulated. Lack of temperature control, and the irregularities that are inseparable from specimens packed by hand pressure or by mallet blows in the ordinary dental way still further confuse the results. It is no wonder, then, that we find officially reported[16] to the National Dental Association results of Black micrometer tests on the same high-grade alloy that range from 1 to 20 points expansion.[17] Even one of Black's own pupils in alloy-making, after 20 years of almost daily experience with the instrument, found the results entirely too unreliable for making further progress in the manufacture of an alloy of the highest grade. And no other instrument of the accuracy[18] required for the refinements contemplated had yet been invented. It was for this reason that I was called upon to design suitable instruments and to reinvestigate the whole problem with all the facilities now available for metallographic research.

12. Thermostated Dilatometer Designed by Author.

An exterior view of one of the instruments that I designed for studying reaction expansions appears in Figure 22. It is a thermostated linear dilatometer capable of measuring displacements with an accuracy of 0.05 micron=1/500,000 in., which is one-fiftieth the least count of Black's amalgam micrometer. Moreover, it is provided with arrangements for cooling and for heating, so that a

[16]Dental Cosmos, Vol. 55, P. 57-59; 1913.

[17]One "point" expansion represents a movement of 0.0001 in. = 2.5 microns in the measuring point that presses against the specimen. As a means for describing a characteristic of the amalgam it is, however, extremely indefinite; partly for reasons given in connection with Wedelstaedt tubes, partly because the dimensions of the cavities in these tubes do not conform to any fixed standard. Black (Dental Cosmos, Vol. 38, P. 967; 1896) in defining a "point" as 0.0001 in., says, "Its relative value in shrinkages or expansions is one in three thousand, lineal measurement," an idea which he repeats on P. 975, where he gives the dimensions of the cylindrical cavity as 0.38 in. in diameter by 0.30 in. in depth. Elsewhere (Ibid., Vol. 37, P. 639; 1895) he gives 0.38 by 0.38. On the next page he gives ⅜ by ¼. McCauley (Ibid., Vol. 55, P. 56; 1913) gives 0.33×0.38.

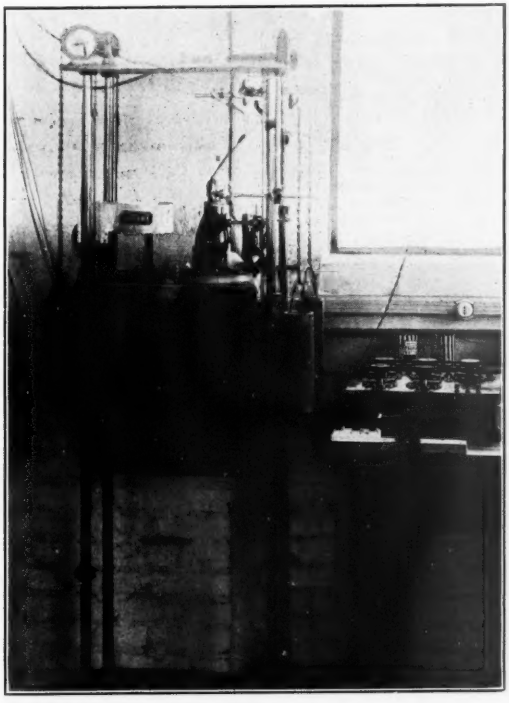
[18]By "accuracy" is meant all that this word implies; not "least count," which can easily be made as small as one pleases by merely increasing the multiplying factor (and at the same time increasing the errors) of the instrument; nor even "precision" of repeating a given measurement. "Correctness," "reliability," are meant.

specimen under observation can be maintained at any desired temperature from below —50°C. to over +300°C.

The amalgam specimens used with this dilatometer are molded into short, right circular cylinders 1 cm. in diameter. Three views of such a cylinder are shown in Figure 23. The small axial holes molded into each base are for supporting the specimen between centers, so that it will be perfectly free to expand or contract radially. The radial groove near the circumference of one base is for engaging the pointed end of a screw which prevents the cylinder from turning on its axis. This insures that the contacts for transmitting the displacements to the multiplying mechanism will always bear against the ends of the same diameter. The cylinders are prepared just as those used for crushing tests (p. 516). This method very accurately makes all the cylinders of the same diameter, so that the insertion of a fresh cylinder never requires the readjustment of the instrument to bring the scale within the field of the telescope by which it is read. Moreover, the cylindrical surfaces are so smoothly formed that reliable bearings of the measuring contacts are assured.

The multiplying mechanism is a combination of mechanical and optical levers so designed that the pivotal and fric-

Figure 22.



Thermostated dilatometer designed for accurately measuring dimensional changes during hardening of amalgam at controlled temperature.

tional errors almost always present in such arrangements are eliminated. A simple optical device eliminates errors that would otherwise proceed from those minute changes in the relative positions of telescope, mirror, and scale that are constantly taking place in all such appa-

Figure 23.

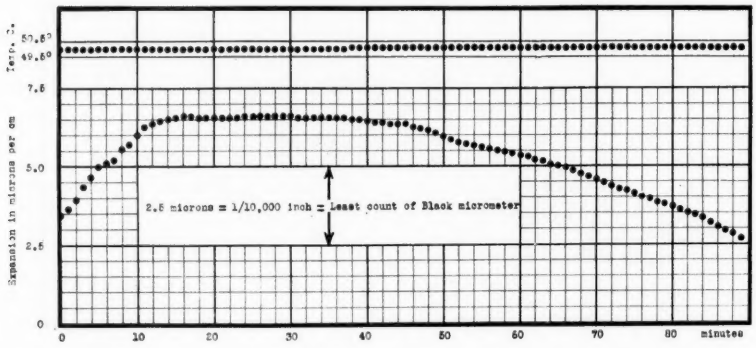
Three views of amalgam cylinder used in measuring reaction expansions to an accuracy of 0.05 micron. Natural size.

ratus. My instrument, which is in daily use, is so little sensitive to external disturbances that nothing short of a direct blow will vitiate its readings 0.05 micron. Still, the moving parts are so delicately adjusted that the measuring sions from minute to minute thruout the day. Measurements can be started within 1 min. after a cylinder has been molded; but the first two or three observations are likely to be affected by small errors caused from disturbing the temperature when the oil-bath is lowered long enough to permit the insertion of the specimen.

13. Graphical Representation of Reaction Expansions.

A series of individual observations made 1 min. apart are plotted in Figure 24. This represents the results obtained during only 1½ hr. of an 8-hr. run. In order to include the entire series of a day's observations in a single chart of convenient size, the original plot is made on the scale of 1/40 in. to the minute, which brings the points so close together that they must be represented in the published charts as continuous curves

Figure 24.



Graphic representation of reaction expansions. Detail of curve shown in Figure 25 between black dots. Individual observations made with dilatometer every minute while determining dimensional changes that occur during hardening of a dental amalgam. Instrument reliable to 0.05 micron =1/500,000 in., which is 1/50 least count of Black micrometer. During measurement with dilatometer, amalgam is maintained at desired temperature by thermostated stirred oil-bath.

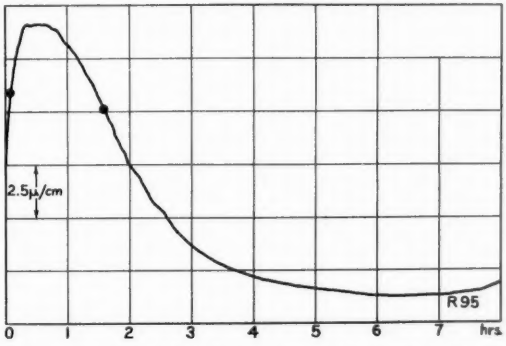
contacts that bear against the amalgam can be separated by such a small force as that produced by pressing sidewise with the tip of a camel's hair brush.

The amalgam dilatometer is used for following the course of reaction expan- (drawn by tracing the original plots). Such a curve is shown in Figure 25. The part included between the two prominent dots represents exactly the same observations as the lower chain of dots shown in Figure 24. The upper chain

of dots represents the temperature observations. Since the temperature of the dilatometer bath seldom varied more than 0.1°, its record is not shown in subsequent charts. In all of these, the base of a small rectangle represents 1 hr., the altitude an expansion of 2.5 microns = 0.0001 in. (approximately) in the 1-cm. cylinder of amalgam.

Figure 26, which represents the behavior of a different amalgam, is presented merely to show how accurately results can be reproduced with a given alloy. Cylinders R 151 and R 154 were made on separate days. The two curves obtained are almost exactly congruent. As will be seen later, this affords a most delicate test for the uniformity of the technic employed in preparing the amalgam cylinder from the filings of alloy, as well as for the reliability of the dilatometer in recording such minute displacements.

Figure 25.



Curve representing dimensional changes occurring in dental amalgam during first 8 hr. of hardening.

14. Typical Reaction Expansion Curve.

From a group of several hundred curves representing reaction expansion in a dental amalgam under various conditions, a few are selected to illustrate certain general principles. Contrary to the generally accepted teachings of Black, the dimensional changes of an amalgam from the same alloy can be very profoundly altered by altering the manipulation.[19]

In the curve representing the behavior of specimen R 180. Figure 27, there is a slight contraction followed by a slow expansion, which in turn is followed by still slower contraction. This is the typical reaction expansion curve for a dental amalgam. This assertion does not mean that all the curves actually obtained look more or less like this one, but rather that every curve so far obtained may be regarded as one of a continuous family, the individual members of which result from progressively transforming a curve of this shape. By appropriate modifications of the alloy and of the manipulation accompanying

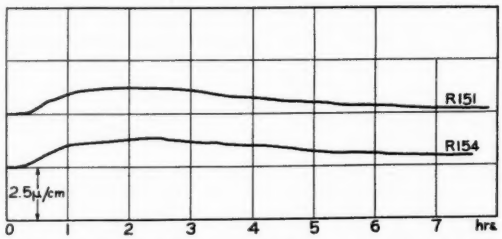
[19]Black states that "Shrinkage and expansion of the amalgam used is not under the control of manipulation by the operator. This can be controlled only in the selection of the alloy to be used. Shrinkage or expansion is controlled by the proportions of the metals of which the alloy is formed, and their relations to each other as alloyed or mixed. In the particular compound selected for use, shrinkage or expansion does not depend upon the proportion of mercury; further than that, wide shrinkages or wide expansions can in some degree be modified as to extent, not controlled. As these are only modifications and do not control, they are unimportant in the manipulative sense; the question of shrinkage and expansion resolves itself exclusively into that of the correct balancing of the metals in the alloy." "Operative Dentistry," Vol. 2, P. 319. Chicago, 1908. Medico-Dental Pub. Co.

amalgamation we can produce all the gradations in form that separate one curve from another which at first sight seems to bear no relation to it. Some concrete examples will make this clear.

15. Influence of Packing Pressure.

The three specimens represented in Figure 27 were prepared by triturating

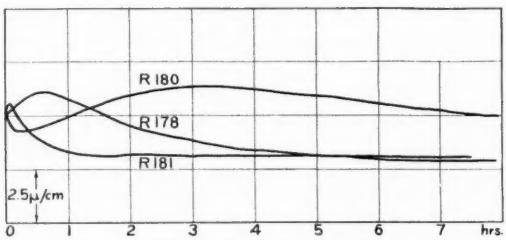
Figure 26.



Showing reliability with which two cylinders of amalgam from same alloy can be prepared and measured.

together the same proportions of the same alloy and mercury for the same time. All were packed for 2 min. in a mold at 37.5°C. and were kept at this temperature during the observation of their dimensional changes. The differences in shape are produced solely by changing the packing pressure from 100 kg. per cir. cm. with R 180 to 400 kg. cir. cm. with R 178 and 1600 kg. per cir. cm. with R 181. The increases of pressure progressively shorten the time consumed in reaching the stages corresponding to the minima and the maximum. The change from 100 to 400 kg. per cir. cm. accelerates the reaction to such an extent that the initial contraction observable with R 180 is over before observations can be commenced; it has apparently taken place in the mold. The change from 400 to 1600 kg. per cir. cm. produces a further acceleration of the reaction; so that the maximum, which was reached by R 180 only after the lapse of 3 hr., is reached by R 181 in about 4 minutes. Such an increase in

Figure 27.



Typical reaction expansion curve (R180) and modifications caused by increase of packing pressure.

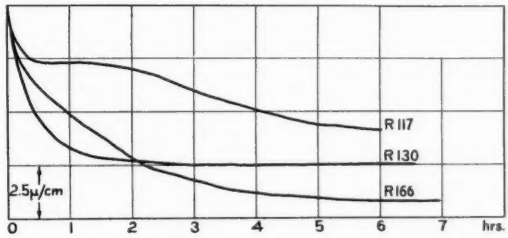
the reaction rate is just what one might reasonably expect from the more intimate union between mercury and alloy that accompanies increase of packing pressure.

16. Influence of Trituration Time.

Again, accelerating the reaction by increasing the trituration time from 1.5 to

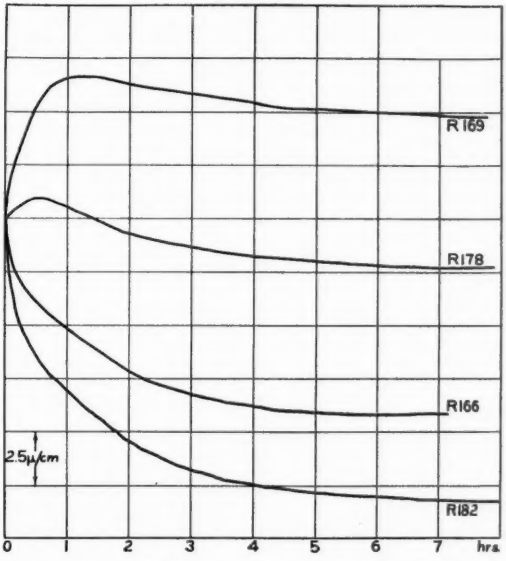
4.0 min., while keeping all other conditions the same, changes the appearance of the curves from that shown in Figure 27 to that shown in Figure 28. R 180 has been transformed into R 117, R 178 into R 166, and R 181 into R 130. In these the faint remains of the maxima so prominent in Figure 27 may be seen. The progressive alteration in shape as the trituration time is progressively increased is, perhaps, still more clearly shown by Figure 29, which reproduces R 178 and R 166, and adds two other curves for the same packing pressure of 400 kg., the first of which (R 169) shows the result of shortening the trituration time to 0.5 min., the second (R 182) the result of lengthening it to 6 minutes.

Figure 28.



Variations of curves shown in Figure 27 produced by increasing trituration time

Figure 29.

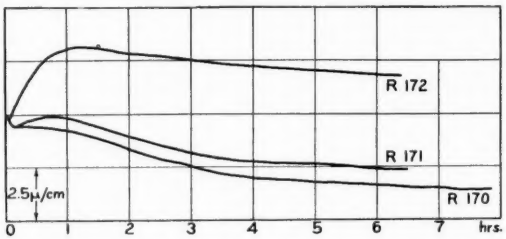


Effects produced by variation of trituration time.

17. Influence of Temperature.

Figure 30 shows how reducing the temperature from 37.5° to 25.0°C. transforms curves R 169, R 178, and R 166 into R 172, R 171, and R. 170, respectively. This is merely an example of the familiar fact that reduction of temperature usually retards the rate of a chemical reaction. By cooling to 5 or 10°C., I have produced such a retardation that it takes many hours to establish the existence of a slow contraction following the flat maximum.

Figure 30.

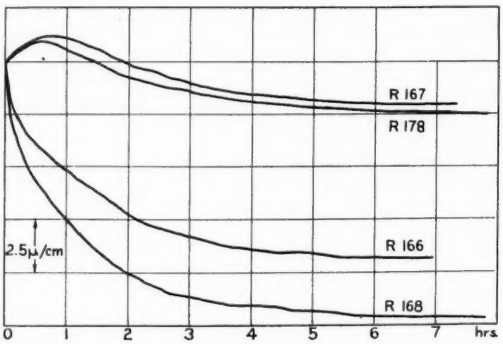


Transformation of curves of Figure 29 by reducing temperature from 37.5° to 25° C.

18. Influence of Mercury-alloy Ratio.

Figure 31 shows the effect of changing the mercury-alloy ratio. The amalgams for R 167 and R 178 were both triturated for 1.5 min.; but the mercury-alloy ration was 1.40 in the former and 1.60 in the latter. The amalgams for R 166 and R 168 were both triturated for 4 min.; but the mercury-alloy ratios were 1.40 and 1.60, respectively. All four specimens were in other respects treated alike, being packed for 2 min. under 400 kg. and observed at 37.5°. When the mass of mercury is 1.40 times the mass of alloy with which it is mixed, it is considerably more difficult to obtain a smooth, plastic amalgam than when the ratio of these masses is increased to 1.60. Increase of trituration time still further increases the plasticity. Figure 31 shows how more thoro amalgamation actually changes the reaction rate in the direction

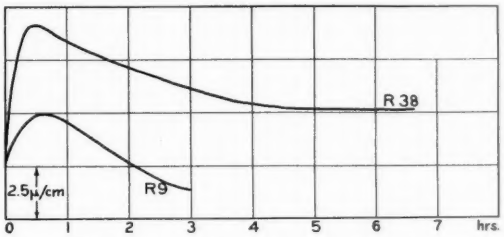
Figure 31.



Effects produced by changing mercury-alloy ratio and trituration time.

in which we might naturally expect some change. Figure 32 represents changes brought about by increasing the mercury-alloy ratio from the very low value of 0.60, used for R 38, to the very high value of 2.00, used for R 9. Both specimens were triturated for 1.5 min. and packed for 8 min. under 400 kg. The reaction expansions were measured at 50°C.

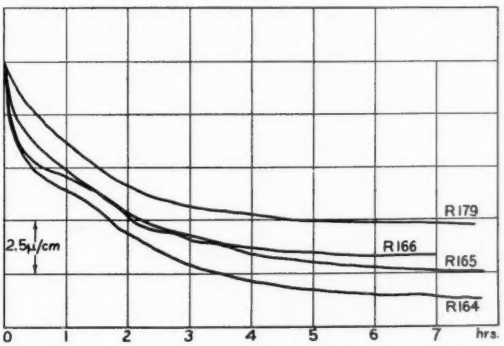
Figure 32.



Effect of large change in mercury-alloy ratio.

min. to 8 min., as follows: ¼ min. R. 165, 1 min. R 164; 2 min. R. 166; 8 min. R. 179. The dimensional changes were measured at 37.5°. Some of the difference in the general positions of the curves is due to the fact that as the packing time is progressively increased, the time available for observation in the dilatometer is decreased. This results in some obliteration of the initial steep descents in the curves.

Figure 33.



Small effects produced by varying packing time.

19. Influence of Packing Time.

The small effect of packing time is shown by Figure 33. All specimens were triturated for 4 min. with a mercury-alloy ratio of 1.60, resulting in rather thoro amalgamation. All were packed under 400 kg. The time during which this packing load was applied varied from ¼

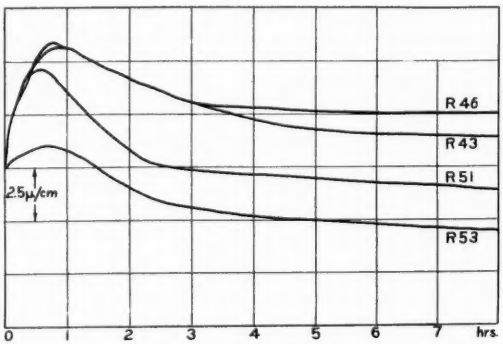
All of the transformations that have been illustrated by Figures 27 to 33, inclusive, were brought about by controllable changes in the manipulation of amalgams made from the very same batch of alloy, that is to say, by changes which

must necessarily creep into any procedure for testing dental alloys for dimensional changes during hardening. It is clear, therefore, that unless all influencing conditions are properly controlled, the results of such a test lead to misleading conclusions. There are still other transformations that may be produced by purely physical treatment of the alloy before it is mixed with mercury to form an amalgam.

20. Influence of Annealing Alloy.

Annealing is an important instance of physical treatment. The temperature and the time required to anneal an alloy in order to produce the best product are of great importance in its manufacture. But these cannot be known until we know precisely how annealing modifies the properties of amalgams made from various alloys. Figure 34 shows some effects of annealing the alloy represented by Figures 27 to 33. R 53 was annealed for 5 days, R 51 for 10 days, R 46 for 15 days, and R 43 for 25 days.

Figure 34.



Effects produced by varying annealing time of alloy.

21. Influence of Size of Alloy Particles.

The size and shape of the alloy particles influence the reaction expansion. The three curves shown in Figure 35 were obtained from the same batch of alloy filings manipulated in exactly the same way, as far as amalgamation, packing, and temperature are concerned. But the particles used for R 58 were too coarse to pass thru a sieve of 48 meshes to the inch, those used for R 59 passed thru one of 200 meshes, and those used for R 66 were extremely fine. As the alloy is made progressively finer, the expansion curve undergoes the same sort of transformation that accompanies increase of trituration time (Figure 29) and increase of mercury-alloy ratio (Figure 31); that is to say, reducing the size of the alloy particles facilitates the amalgamation, a result that we might have expected in kind if not in degree. But curve R 66, after reaching its minimum, takes a slight upward turn, suggesting that there may be still another maximum beyond the second minimum of our type expansion curve R 180 of Figure 27.

22. Extension of Typical Expansion Curve.

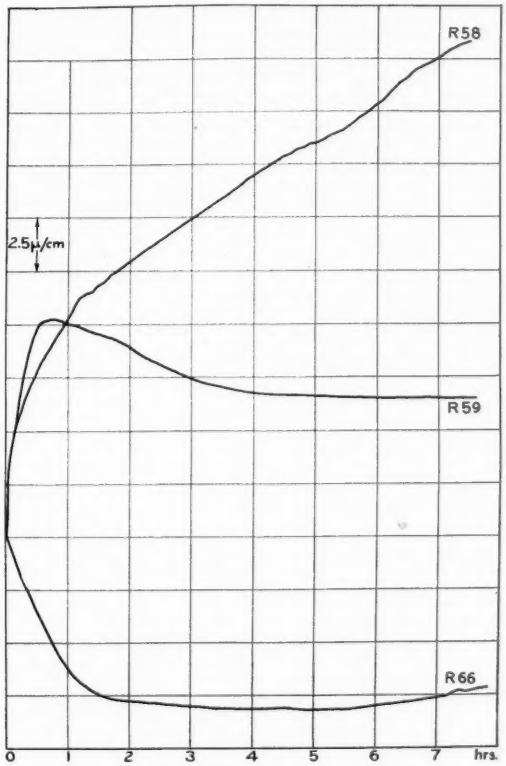
By progressively increasing the thoroness of amalgamation, more and more of the early portions of the type curve are wiped out. At the same time the rate of reaction is increased so that the characteristic features make their appearance

sooner and stand out more prominently. Therefore, if the slight rise at the end of R 66 really indicates the approach of another maximum, and not a mere vagary of the apparatus, more thoro amalgamation ought to emphasize this feature of the curve. Since the curves of to 6 min. trituration with mortar and pestle followed by 10 min. kneading in the hand.

23. Influence of Thermal Softening and of Reamalgamating a Hardened Amalgam.

As a final example of transformations

Figure 35.



Effects of changing size of alloy particles.

Figure 35 were obtained with a mercury-alloy ratio of only 1.40 and a trituration time of only 1.5 min., it was easy to test the matter. Figure 36 shows how R 59 and R 66 were thus transformed into R 62 and R 67 upon increasing the mercury-alloy ratio to 2.33 and the mixing brought about by physical treatment of this same alloy, Figure 37 is given. It shows results obtained by heating a hardened amalgam until it softens (R 39), and by mixing more mercury with filings from a hardened amalgam (R 40).

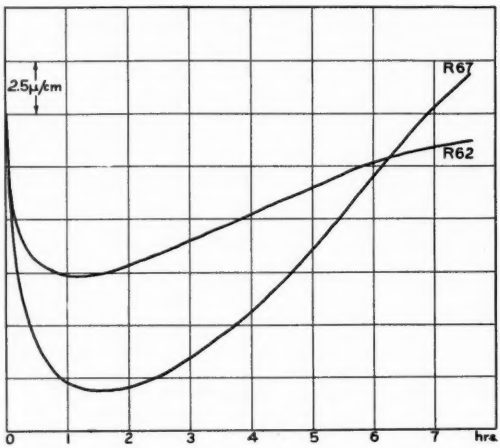
24. Curves Obtained with a Variety of Dental Alloys.

I shall conclude my exhibit of data by presenting without much comment a few curves obtained with amalgams from several different alloys. Figures 38 to 44, inclusive, are typical. Figures 25 and 26, which were introduced to illustrate precision of apparatus and technic, might be considered with this collection.

III. PRACTICAL APPLICATIONS OF THE RESULTS.

The determinations of both crushing strength and dimensional changes during hardening show how profoundly the behavior of an amalgam may be influenced by such things as mercury-alloy ratio, trituration time, packing pressure, temperature during hardening, temperature during testing, and age of amalgam, as well as by the characteristics of the particular alloy under test. Therefore, comparisons of different dental alloys are worth little unless it is shown that proper attention has been given to the control of all such factors. It is just because such control is lacking that we must discard as worthless a great many of the tests that have been made with the Black dynamometer and with the Black and other micrometers. The traveling microscope, even tho it be possible to repeat readings to within 1 micron or less, may conceal large instrumental errors, while the Wedelstaedt test tube is fundamentally wrong.

Figure 36.



Extension of typical reaction expansion curve R 180 of Figure 27.

25. Copper Amalgam.

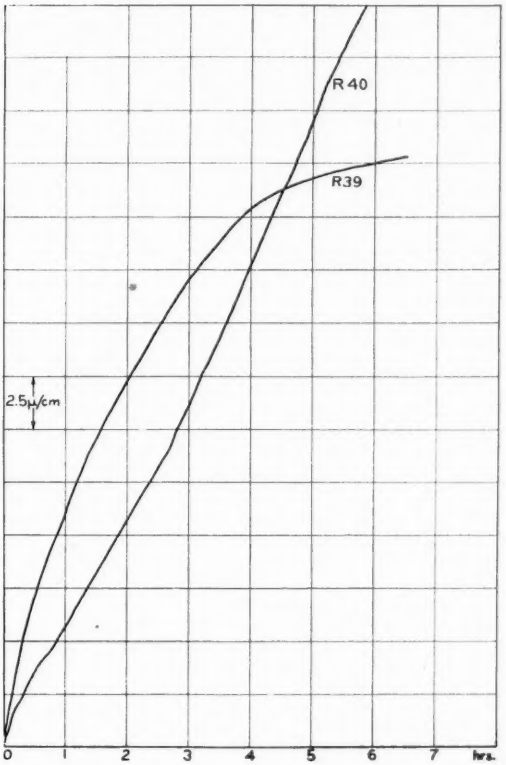
It may be of interest to point out that Figure 44 reproduces two curves obtained with pure copper amalgam. Both of the specimens represented were packed for 2 min. under 400 kg. per cir. cm. The dimensional changes were measured at 37.5°C. R 185 was triturated for 1.5 min., R 184 for 4 min.[20]

[20]Ward (Jnl. Allied Denal Soc., Vol 11, P. 457; 1916) says, "With the use of copper amalgam there seems to be a different phase of the problem confronting us at once. In the first place it does not change in volume to a degree that has been detected by any methods of measuring volume change at present known. It is supposed to be free from either contraction or expansion."

Contrary to general opinion, the soft, fine-grained amalgam obtained by long continued trituration with plenty of mercury hardens into a stronger filling than does a less plastic mix. By making the alloy so that the last movement shall be

cedure that brings about more intimate contact between the alloy particles and the mercury, and thereby accelerates the reaction, results in shortening the time required for the filling to reach its final, stable condition.

Figure 37.

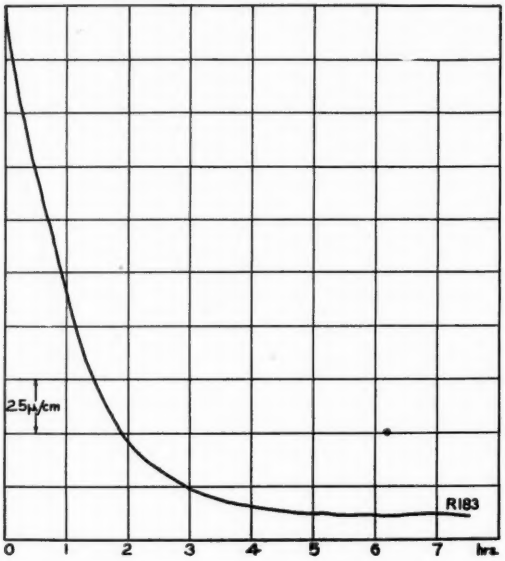


Effect of softening a hardened amalgam by heat (R 39) and of reamalgamating (R 40).

an expansion of desirable amount when a practicable packing pressure is employed, we secure a filling that approaches the ideal in regard to rapid hardening, final strength, plasticity, and volume changes. A fine-grained, plastic mass that expands slightly during hardening makes for tight fillings. Any pro-

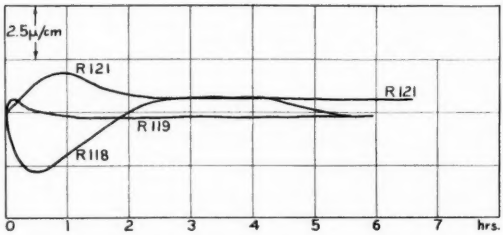
The production of a dental alloy to fulfill these requirements entails not merely the selection of a suitable formula, but also careful attention to various physical details of manufacture. A high-silver amalgam within a few hours becomes as strong as a low-silver amalgam ever becomes and finally attains a

Figure 38.



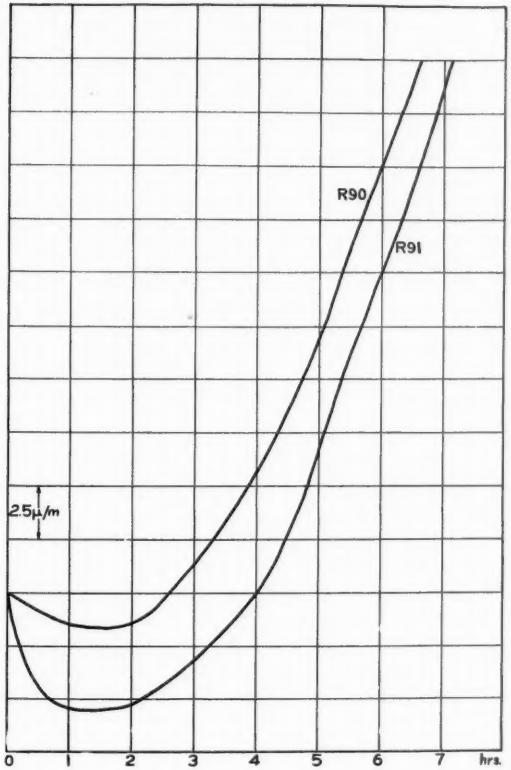
Amalgam from a low-silver alloy. Excessive contraction.

Figure 39.



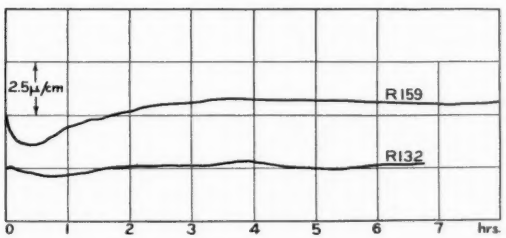
Amalgams from high-silver alloy showing characteristic curve and modifications produced by progressively increasing packing pressure (R 118, R 121, R 119). Compare with Figure 27.

Figure 40.



Amalgams from another low-silver alloy. Contraction followed by excessive expansion.

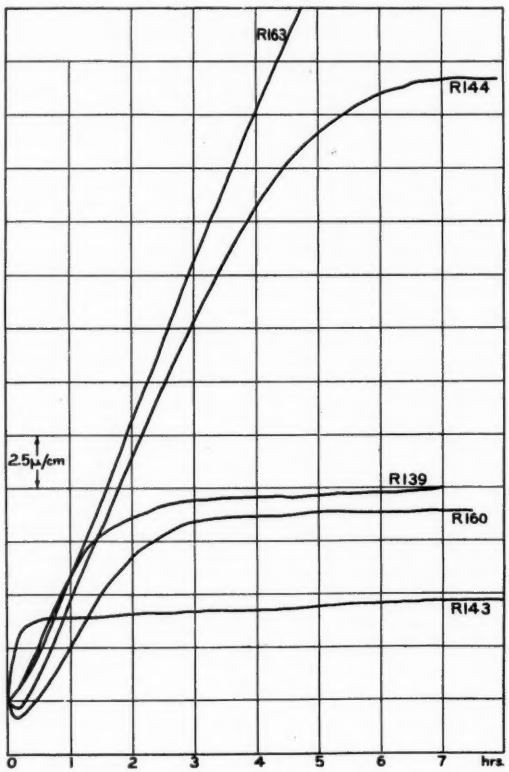
Figure 41.



Amalgams from two high-silver alloys.

strength about 75 per cent. in excess of that attained by the low-silver. A given weight of a high-silver alloy makes a considerably larger filling than the same weight of a low-silver alloy, because it unites with more mercury, which is compensated by means of a recently invented process that removes from the annealed comminuted alloy surface impurities which hinder union with the mercury. The second, that a high-silver alloy requires more rapid manipulation, can be

Figure 42.



Amalgams from high-silver alloys.

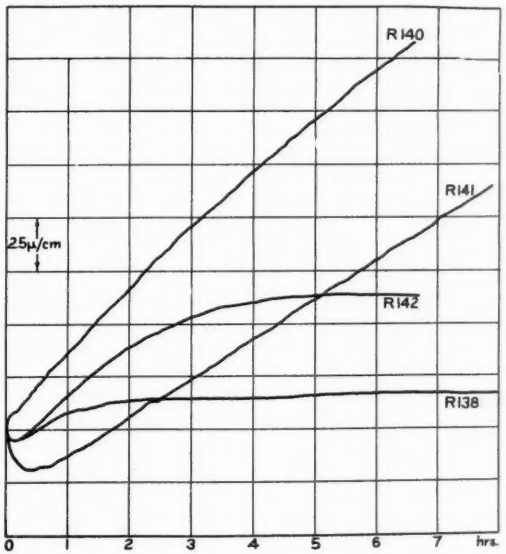
paratively cheap. Consequently, it often proves more economical to use the high-silver alloy, which is superior from every point of view.

Two objections are sometimes raised against the use of a high-silver alloy. The first, that such alloys amalgamate with some difficulty, has been overcome by means of a recently invented process that removes from the annealed comminuted alloy surface impurities which hinder union with the mercury. The second, that a high-silver alloy requires more rapid manipulation, can be overcome by proper manipulation. After triturating thoroly with sufficient mercury to make a smooth, plastic mix, the dentist has merely to avoid expressing the excess mercury until just before placing the amalgam in the cavity. Moreover, an amalgam that has already be-

gun to harden slightly may be softened again without loss of strength by adding a little more mercury and working the mass until again plastic.

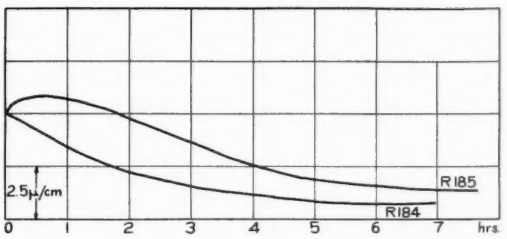
meters, indicate the possibility of analysis into a group of superimposed curves of the exponential type, suggesting strongly a complicated reaction or transition that is separable into several elementary components which progress simultaneously and successively at different rates.

Figure 43.



Amalgams from high-silver alloy.

Figure 44.



Copper amalgam.

The form assumed by the type curve of reaction expansion, and the transformations it may be made to undergo by suitable control of the fundamental para-

PREVENTIVE DENTISTRY.

By Russell W. Bunting, D. D. Sc., Ann Arbor, Mich.

(Read before the Michigan State Dental Society, April 7-11, 1919.)

DENTISTRY today is on trial. Accusation has been brought against her that she is a menace to public health, that many of the things which she has done in the past to save teeth, have resulted in disease and disaster to the individual, and that beautiful restorations and extensive reconstructions which she has made are in reality "whited sepulchres" from which insidious poisons continually seep and spread thruout the body. She has, in fact, been challenged to show the integrity of her purpose and proof of the safety of various dental procedures. What is safe and sane in dentistry and when does it cease to be a menace?

Dentistry has responded to the challenge and is seeking to meet the issue. She recognizes that systemic infections may gain entrance to the body thru the oral tissues and that certain of these are connected with dental operative procedures; also that danger lies in many peridental infections which have formerly been overlooked or given scant consideration. So forcibly have these facts been brought home to her that she can no longer evade them. It has therefore become necessary that she inquire very closely into the relation of systemic infection to oral health, and to recognize her whole system of operative dentistry to meet the new situation. It is very evident that the great majority of infections which enter the body thru the oral tissues do so thru two specific channels; one, periapical infections about the roots of devitalized teeth, and the other, pyorrhetic affections of the peridental tissues. It is toward these two types of oral infection that attention has been directed.

In the effort to eradicate the first of these infections (periapical) intensive study has been made of the treatment of pulpless teeth. Strenuous efforts have been made to perfect the technic of pulp canal operations in the attempt to devise a method which is above reproach. In spite of all that has been done in this regard, the attempt has not resulted so far in unqualified success. A few operators, by infinite pains and most careful technic, have attained a high degree of success; but the great majority of dentists are still treating and filling root-canals in a manner that is open to serious criticism. And, indeed, it will never be otherwise until an easy, certain, foolproof method is devised by which the average man as well as the expert, shall be able to treat and fill root-canals in a manner that is above reproach. Then, and not until then, may dentistry justify the retention of all devitalized teeth.

A relatively small number of practitioners have developed the requisite skill to treat pyorrhetic affections, so that the progress of that disease is permanently arrested and the peridental infections are eradicated. But the great majority of dentists are treating these conditions very indifferently; either do they neglect them entirely or, if they attempt to treat them at all, they do not carry them thru to a successful completion. Dentistry can never justify the retention of pyor-

rhetic teeth unless she adopts measures which will make them unquestionably safe as regards infection.

There are then for dentistry two courses of action if she would avoid criticism and condemnation; one, a perfection of technic in the treatment of pulpless teeth and of pyorrhetic affections so that she can say with authority that the possibility of systemic infection has been removed; the other, extraction of all diseased or suspected teeth. This drastic ultimatum has been delivered to the dental profession by their medical confreres, by their patients, and by the public at large and no matter how severe it may seem, or how difficult the execution may be, the situation nevertheless, cost what it may, must be met.

There is, however, a third course of action which is much more reasonable and *efficient* than the other two and which, if universally adopted, would most *effectually* meet the situation. Could we keep the pulps of all teeth alive and could we keep the peridental tissues in health, we would strike a blow at the root of the difficulty and would prevent the inception of these peridental infections which we have learned to fear. By such measures we would obtain an unquestionable guarantee of the safety of dental procedures and would establish an irrefutable alibi for the mouth as a menace to general health. We may well consider at this time any measures for prevention which have proved to be of value.

When we consider the preservation of dental pulps, it must be admitted that by far the greatest cause of the death of that tissue is dental caries. Pulp conservation, then, may best be accomplished by the limitation of caries inception and the filling of cavities which appear in the teeth before they have become sufficient size to involve the pulp. Volumes have been written upon the cause, course and prevention of dental caries but in all that has been contributed to the subject, there is but one practical method suggested for its prevention which has proved to be of value, namely, oral hygiene in its broadest sense. Dental caries have been recognized as destruction of the tooth by acids resulting from the fermentation of carbohydrates; therefore it is reasonable to expect that the continuous cleansing of the mouth of fermentable food stuffs and the reduction of infections will tend to decrease the inception of caries. By practical demonstration this has proved to be true. Perhaps in the future better and more definite methods of caries control will be determined but at the present time the practice of oral prophylaxis and oral hygiene, as applied to every department of operative dentistry, comprises the most efficient measures of caries prevention.

These measures consist in more than mere cleansing of the teeth. This is but the first step in the process and should be followed by a thoro polishing of the teeth so that they will offer less natural retention for food debris and bacterial plaques. All fillings, crowns, bridges, and so forth, should be so shaped and polished that they will offer the least possible retention to foodstuffs, and in every way the attempt should be made to make the mouth as nearly self-cleansing as possible. The patient must be instructed as to personal care of the mouth, and by encouragement and moral suasion, a cordial cooperation in this work must be gained. The suggestion of certain diets is often of value, such as the selection of hard and tough foods, the reduction of soft, pappy and sugary substances, and the eating of acid foods or fruits at the end of every meal. Unless all of these measures of oral hygiene in its broadest sense are carried out, the simple cleansing of the teeth will prove of little avail.

It is with the children that the greatest measure of success may be attained. The mouths of the adults are already sadly mutilated as the result of past

neglect and are encumbered with various forms of restorations, many of which are of indifferent character and questionable safety. But the children present a field of endeavor which is fresh and as yet unspoiled by the ravages of dental disease. If their mouths are kept clean, they will have far less caries than their parents had before them. And if they are continually watched, the cavities which do occur may be discovered and successfully filled before they have involved the pulps. Thus it is possible and practicable to bring the youth to manhood and womanhood with a full normal compliment of teeth in which every pulp is alive. For them the problem of keeping their mouths in health and free from insidious infections will be far simpler than that of the present generation. Perhaps this form of practice is best accomplished by those of our profession who are confining their attention to the treatment of children. But splendid as this work may be, the number of children who may have such attention is extremely small compared with the masses who receive little or no dental care. Service of this kind is too important to be limited to the wealthy classes, but must be developed rather as a public health measure and placed within reach of all. To accomplish this, the public schools offer the most strategic avenue by which all children may be reached, and it is thru them that the program of universal dental health must be carried out. Already rapid strides have been taken in this direction and everywhere attempts are being made to institute school dental clinic and dental examinations for all school children. But the field is large and the surface has only been scratched while the supply of competent workers is pitifully small and inadequate. Additional impetus has been given this work recently by the advent of a corps of young women trained to serve in the field of preventive dentistry,—the dental hygienists. The work of these women in the public schools of other states has fully demonstrated their value, and by an enactment of our legislature we trust that they may become a reality in this state. Time and effort alone can show what may be accomplished by their assistance in this colossal task. This we know: that preventive dentistry for children is fast becoming a large and important branch of dental service and of public health as well; that it is practicable, beneficial and entirely defensible; and that it is our duty as a profession to support it and advance it in every way possible until it has reached every child in every school in the land.

Preventive dentistry for adults is somewhat more difficult of accomplishment, especially when the mouth has already been severely attacked by dental disease and contains extensive restorations. But in the cases which present themselves in the daily routine of dental practice very beneficial results may be obtained when all operative procedures are made to conform to the principles of oral hygiene. A general reorganization of the mouth to a condition in which it is possible for the patient to keep it clean and teaching him how to accomplish it will always result in a reduction of oral infections and a decrease, and often an entire prevention of the inception of dental caries. Periodic examinations are also necessary for the adult as well as the child in order that assistance may be given in keeping the mouth clean and that cavities may be detected and filled while small for the sake of pulp conservation.

The second class of oral infections, the peridental affections, are much more easily and definitely controlled. The various disease processes known as pyorrhea consist essentially in a breaking down of the hard and soft tissues about the tooth by infective organisms. The inception of the process is not so much due to the presence of a specific type of

organism as it is to a lowering of the resistance of peridental tissues to such infective agents. When in health, the oral mucous membranes form a resistant barrier to keep infections from gaining entrance to the underlying tissues. The most vulnerable spots in this protecting wall are the gingival areas where the mucous membranes surround each tooth. Here nature has intended that the soft and hard tissues shall be so closely connected that infection cannot break thru, and as long as the gingival tissues remain in a healthy state, this is true. But by reason of various local irritants, such as calculus, constant infection, foodstuffs, overhanging fillings, and so forth, the gingival circulation becomes disturbed; active, and passive hyperemia, stasis, and inflammation, follow in rapid succession, and the normal tone and resistance, of these tissues are lost. The various forms of gingivitis and pyorrhetic affections which follow effectually open the way by which oral infections may penetrate the deeper tissues and be carried thruout the system. It is true that occasionally these conditions arise from a lowering of resistance by virtue of some systemic fault, but the far greater majority owe their beginning to local irritations. Could we but keep these gingival tissues free from irritations, they would almost invariably remain in health. So that altho the treatment of advanced pyorrhea is a difficult and highly specialized procedure, the prevention of pyorrhetic affections may be most easily and surely accomplished. In the early stages certain definite signs appear in the gingival tissues, such as changes in color, in form, or in density, which are so apparent that even "he who runs may read." And when these deviations from normal are noted, if the operator turns his attention to removing the local irritations which are disturbing these tissues, a rapid return to normal tone and resistance may easily be obtained. Indeed, these measures are so closely related to the principles of oral hygiene which we have just stated that if they be continued to include the necks of the teeth beneath the free margin of the gum, they will constitute an efficient method of preventing both classes of dental disease.

Oral hygiene has come to occupy a position of importance in the field of dentistry. This department of dental practice which has been given but minor consideration and assiduously avoided by the majority of practitioners in the past, this stone which was rejected by the builders of our profession in earlier days, bids fair to become the corner stone of the new structure which dentistry will build in the future. No longer may oral hygiene be considered as the mere cleaning of teeth, but by virtue of its manifest importance, it dominates all operative procedures and demands that they restore the dental organs to their full normal function to the end that the mouth may offer the least possible retention to foodstuffs and infectious materials. In return, oral hygiene offers to dentistry a most reasonable and defensible alibi to the charges which are now being made against her.

As in a recent editorial in the Dental Cosmos, Dr. Kirk, in discussing the question of preventive dentistry made the following statement: "The hope of the future in dentistry, as well as medicine, is prevention—and the hope of prevention of dental diseases to any considerable degree in the future lies in oral prophylaxis systematically and persistently prosecuted."

ADVANTAGES AND DISADVANTAGES OF REDUCED SILVER IN DENTAL THERAPEUTICS.

By U. Garfield Rickert, M. A., D. D. S., Ann Arbor, Mich.

(Read before the Michigan State Dental Society, April 7-11, 1919.)

THIS paper is offered at this time, because of the large number of inquiries made during the past year, regarding the merits of the so-called silver reduction method as applied in dentistry. At the several district meetings at which we recently appeared, about the first question asked was for an expression regarding this treatment.

For a number of years we had been interested in reducing silver in different types of teeth, not then having in mind so much the possible therapeutic application, as a study of the variation in physical constitution of the several tooth tissues. Naturally this information, with the general knowledge of the sterilizing properties of silver, and with the extraordinary tolerance of the tissues toward silver, added especial interest to the sweeping claims recently made by Dr. Percy Howe of Boston.

Many of you have tried this modern Panacea and found it extremely irritating. We too made up the solutions as recommended and admit that nothing we ever blundered in gave us so much embarrassment as those days of suffering on the part of patient victims. To this date we hate the ring of a telephone because it recalls that voice, "What shall I do, for I just can't stand this thing any longer". The fact of the matter was that there was nothing one could do but resort to general sedatives for these irritations usually lasted from thirty-six to seventy-two hours, during which time the suffering of the patient was very severe.

Now we are in no way trying to minimize the importance of the conscientious work of Dr. Howe, for we recognize that he has pointed out the possibilities of silver in dental therapeutics and certainly few subjects have recently aroused the interest of the profession to a greater degree than the one of silver reduction. If we were to criticize the above efforts, which is not the purpose of this paper, our criticism would be simply this, that judging from our experience with it, it is too sweeping in its claims, somewhat misleading, and too much like magic to be true.

The recruits on the side of promiscuous extractions have been, during the past year, increased at an alarming rate, those of us who have been trying to keep in the middle of the road are grasping at every straw for more positive methods, many operators are willing to try anything, for this reason no method should be given unqualified approval until such methods have been thoroly tried. My own experience with Dr. Howe's method as suggested in his original paper is evidence of the harm that may come by giving out a misleading technic. Radiograms of the cases of extreme irritation of over a year's standing are not at all encouraging. Dr. Howe tells us that it is unnecessary to put any of these irritating solutions thru the teeth. He infers that by placing a small amount into the pulp chamber, it will be carried just to the end of the canal and not thru. My experience has been somewhat differ-

ent, possibly due to less operative ability on my part.

We have not always been able in the mouth or in most extracted teeth where the apical foramina were sealed, to have absolute control of the end point. In situ, it will either not go quite to the end or, if carried into the canals with broaches, it will go thru. Evidently then it was necessary to modify the treatment so that if a small amount did pass to the periapical tissue, it would not be so irritating. Unless we are able to completely fill canals to the end we are defeating the very purpose we desire. We might as well use any other filling material if filling as far as possible were sufficient. One need only examine the illustrations accompanying Dr. Howe's paper to observe that Dr. Howe filled to the end in extracted teeth, but some of those treated in the mouth show little or no silver at the apices.

For the benefit of those who are interested in knowing to what extent we have been able to verify Dr. Howe's seven applications, a brief discussion of the several claims will be given at this time. Quoting from the original paper, —application number one: "It is effective in the sterilization of disintegrated dentin overlying pulps as in large cavities of carious first molars."

The treatment has been modified so that cases of a year's standing give promise of developing into a sound technic. After careful bacteriologic tests we know, at this time, of no surer or better way for the sterilizations of infected dentin. The technic used will be given later in this paper.

Application number two: "By this method it is possible to completely sterilize not only a putrescent pulp without removing it, but also the dentinal structure as well."

We have proven that it is possible to sterilize such pulps but for reason to be given later we question its application in practice.

Application number three: "In acute pericementitis following the death of the pulp, it is only necessary to pump this material into the pulp chamber and into the canals as well as possible and close the tooth. The pericementitis in such cases as we have treated, has been quickly allayed and a subsequent and more thoro treatment has apparently ended the trouble."

We have been unable to substantiate this statement. Judging from the reports of an enormously large number of operators, it is easier to believe that it has caused more cases of pericementitis than it has allayed.

Application number four: "We have found it effective in the treatment of chronic abscesses." We have learned from bacteriologic test and clinical observation, in both temporary and permanent teeth that silver is not well adapted to sterilization of periapical tissue, other treatment should be used and silver depended upon to fill the apical foramina and sterilize the dentin.

Application number five: "We believe this to be an admirable means of taking care of apical foramina in all cases if properly used."

Our findings have been in accord with the first part of this statement, but we are not ready to justify its use in all cases as suggested in the second part of claim five.

Application number six: "It is an excellent means for almost painlessly removing the remaining part of a pulp, after the death or removal of a portion of it."

As to this statement we have little to say for we have had no occasion indicating its use. It will probably accomplish what is claimed for it, especially if the reducing agent is formalin. Formalin and certain of its compounds will do the same thing. We question, however, the promiscuous use of such drastic treatment in uninfected teeth.

Dr. Howe's seventh claim: "Applied

to the root ends after apioectomy it lessens the probability of subsequent trouble."

A number of cases of a year's standing under our observation are evidence that if properly applied there are several good reasons for this procedure. A discussion of the technic of the same will be taken up later.

Our conclusions regarding the several silver treatments are based first, on some well established therapeutic and bacteriologic principles. Second, on clinical observation; third and last, laboratory experiment. It will be evident that the time for clinical observation has been limited. Our cases of longest standing are only of fifteen months duration. Years only will verify whether or not our deductions are absolutely sound.

This is a day of preventive dentistry, for this reason the preventive applications of reduced silver will be considered first. The simplest conditions indicating silver for prophylactic reasons are areas susceptible to caries in temporary teeth. We next have the small cavities where it is impossible to do ideal work. In such cases one may, by a little care, inhibit further development of caries. You have all seen small cavities into which silver has been reduced years previous, in which there has been no further decay. In tomorrow's clinic sections of teeth will be exhibited, showing the resistance toward weak acids where dental structures have been impregnated with reduced silver, as compared with untreated sections. Now, in the treatment of these conditions, the amoniacal solutions offer no special advantage over an ordinary silver nitrate solution.

Likewise sections of teeth will be exhibited intending to demonstrate that the latter is even to be preferred because of its greater penetration in conditions where the protoplasmic processes of the dentinal tubules have been destroyed; where this is not true the amoniacal solutions penetrate farther. Silver nitrate is less easily reduced from its cold solutions than the amoniacal solutions and consequently penetrates further in dentin before being reduced by the action of light and organic matter, providing the protoplasmic processes have been destroyed. We have repeatedly demonstrated in our studies of permeable membranes, the impermeability of dental tissues in which there has been a reduction of silver. Dentin and enamel tnus treated become clogged with silver, consequently are not so easily affected by chemical action.

Before giving details of technic of the several applications where reduced silver has, in our hands given a measure of success, several terms to be used later will be defined.

Slow reduction.

By this term you are to understand that a number of days are required before reduction to the metallic state is complete. By rapid reduction we imply that the reduction is more or less complete in a few minutes. In our experience there are indications for the use of one or the other of these distinctive types of reduction.

A few years ago it was our practice either to devitalize or to extract teeth from which we were unable to remove all decay because of proximity to the pulp. For reasons which need no discussion here, we are making more strenuous efforts for the conservation of healthy pulps. The treatment we are about to describe for the above condition has been applied in a large number of cases. Pulps of this kind treated fifteen months ago that were recently tested were found to be in excellent condition. Results of a large number of more recent treatment are also very encouraging. The treatment used is as follows: First apply the rubber-dam, then prepare the cavity so that there is a sound enamel wall. Remove soft and infected dentin avoiding too near exposure of the pulp. The dentin must be cut so that

there will be some firm dentin in the line of force of mastication for the cement to rest upon. The cavity is dried avoiding excessive heat. The cavity is then ready for the rapid reducing silver, the preparation of which will be described later. By a little care the silver may be applied without discoloring the margins. Eugenol or even dentalone, may be used as the reducing agent which should be applied several minutes after the silver solution. The excess should be removed and the treatment repeated several times. The excess is again removed and the wall in close proximity to the pulp is slightly moistened with eugenol and this area is covered with a thin layer of dry zinc oxide which is easily held in position by the moist surface. The reason for the latter is twofold: It insures complete reduction of the silver near the pulp. This shortens the time, which is very essential of serious irritation. The zinc oxide admits of a thinner mix of cement, consequently close adaptation is made possible without pressure to the frail pulpal wall. There is no irritation because of excess phosphoric acid, for such excess is taken care of by the layer of zinc oxide. After capping with the cement, the cavity is ready for whatever restoration is desired.

While we are not giving this treatment as a finished method, it is safe to say that results of a large number of cases for the limited time we have had in which to observe such results has been very satisfactory. Careful tests should be made to make certain that there has been no serious degeneration of pulp preceding this treatment. If formalin is used for the reducing agent, it must be very dilute and enough silver solution must be used to insure complete decomposition of the formalin. The cavity should be treated with sodium bicarbonate to neutralize the acidity following the reduction with formalin. This, however, is unnecessary where essential oils are used as the reducing agent.

The silver solution used for rapid reduction is made up as follows: Silver oxide is precipitated from a silver nitrate solution with KOH or NaoH. This is carefully washed to remove all impurities and kept moist in a small amber colored bottle. In this condition reduction is so slight that we have kept it for a long time without much change. If a small amount is insoluable in excess of ammonia, there has been too much reduction and the silver oxide should be freshly prepared. This is our stock solution and it will be seen that it is more desirable than the ammoniacal solution made from silver nitrate, because it is free from nitric acid and other impurities.

Now when we desire rapid reduction as in a pulp capping or root resection, the silver oxide is added to a drop or two of ammonium hydroxide to the point of saturation. In this state the amoniacal solution is easily reduced. The ease with which reduction takes place with this solution is so marked that even burnishing with a warm glass rod is sufficient to reduce to the lustrous metallic silver. There is one precaution that must be mentioned here. That is that after a few hours, fulminates of silver may be formed from the amoniacal solutions, which are very explosive. I have taken old solutions of both Dr. Howe's and my formulas and incompletely reduced the same in teeth or on blotting paper, both producing explosions on being touched with a hot platinum wire or by use of the electric current. Serious accidents are possible from even wet solutions. Only very small amounts of amoniacal solutions should be made and the unused portion discarded immediately after treatment. After complete reduction there is no danger and only old amoniacal solutions, especially after drying, are to be avoided.

The filling of apical foramina deserves especial attention. The possibility of filling difficult canals with reduced

silver, providing the irritating properties were eliminated, prompted investigation as to the cause of irritation. The following experiment is an explanation of the probable cause. An amoniacal solution of silver was reduced with formalin, another with eugenol. The freshly reduced silver is filtered and reaction of the filtrate tested. The filtrate from the formalin reduction is at first strongly acid, but on standing a few hours or on heating the acidity is diminished.

Now if by the aid of a needle, a little of this filtrate is passed beneath the skin, it will produce a smarting sensation not unlike the bite or sting of certain insects. Since formic acid has been demonstrated in the secretions attending such stings, one would be inclined to suspect formic acid in the above mentioned filtrate. The filtrate where eugenol is the reducing agent does not produce the smarting sensation. Time did not admit of more elaborate tests and the specific acid is by no means proven by this simple test. The experiment was evident that the amount of formalin should be diminished far below the amount suggested in Dr. Howe's paper. A large number of cases in which the formalin was diminished and eugenol or dentalone and sodium carbonate were substituted, there was no irritation. That there are objections to this technic must be evident because we are introducing too many elements not silver. We are aware of the fact that elimination of the formalin probably diminishes the antiseptic properties. A large number of cases do not require so powerful an antiseptic. The dentin may be filled equally well with the rapid reducing method suggested for nearly exposed pulps without the serious irritation which we have learned to fear more than a few undestroyed bacteria in the remote recesses of the dentin. One advantage of reduced silver for canal filling over other methods is that it does away with the danger of over instrumentation to accomplish complete filling. There is a reason to believe that over instrumentation has been the cause of a great deal more trouble than most operators are aware of. It is unnecessary, if reducing silver is used, to work as close to the apex as required by other methods.

Then ammonia has also been the cause of some of the irritation. There is no doubt that careful preparation of the solutions will prevent this. Infected periapical areas should be treated by methods that have given seemingly good results in the hands of the individual operator. The dentin and apical foramina may be filled with silver after careful cleaning of the canals. Short softened pieces of gutta-percha points are then packed into the enlarged portion of the canal. Where more drastic treatment is required than is possible by the above method, surgical aid, either extraction or root resection seems to be the only avenue of escape at the present time. Numerous tests have demonstrated that silver and formalin will, if properly used, sterilize the canals and dentin of infected roots, but that this sterilization is limited to the tooth and not to tissues far beyond the root has also been repeatedly demonstrated. We have on exhibition a tooth recently extracted in which the canals were filled 15 years ago with copper. There was no discomfort or evidence of infection. The crown had broken down so that only the copper impregnated roots remained. This is a fine illustration of the tolerance of tissues to copper. The roots were jet black, resisting for 15 years the action of body fluids. What copper will do we believe silver will do better.

The possibilities of reduced silver in the preparation of roots for resections, seem to give most encouraging results. The following technic is the one used preparatory to resection. The canals are opened, using the rubber-dam where this is possible, and the silver solution is introduced to the very apex. Five or ten minutes are then allowed for penetration before the reducing agent is applied.

This treatment is applied several times. There is no objection to the use of Dr. Howe's solutions for this operation, because the endangered apical tissue is to be excised immediately following the filling of the canals. The canals are very carefully packed with small pieces of gutta-percha points softened by gently heating. The root is resected and the resected end dried as well as possible and silver, by rapid reduction, is reduced and burnished over the resected end. The latter treatment is essential because dentin is poorly adapted to resist the action of body fluids and, experimentally at least, this procedure prevents resorption. Then to, the silver prevents the exposed softened dentin from becoming infected in the healing process and to later renew the trouble. It also forms another barrier to subsequent infection from the root-canal. It will be evident that after healing of such resections it becomes difficult to have patients submit to the necessary means for obtaining material for bacteriologic tests. We have made but one such test and that was found to be sterile. While this proves nothing, it is at least favorable evidence.

The necessary length of this paper prevented the addition of the chemical and bacteriologic tests made in investigating the possible uses of silver in dental therapeutics. These, with other methods that are under observation, will be presented in another paper to appear later.

A summary:

The possible advantages of reduced silver would suggest its use for prevention of caries, the protection of nearly exposed pulps, the possibility of filling certain tortuous canals, and preparation and treatment in root resection.

As to the disadvantages, the instability of the solutions, the discolorations attending its use, and possible irritations are the most important. While these disadvantages are subject to control, they offer no encouragement in root-canal work to operators desiring a method infallible in careless operations. The fact that silver solutions properly reduced will sterilize should not be depended upon to admit of less care than that required by other methods. We caution operators not to be over confident in the sterilizing properties of silver, and take too long chances. There is already evidence that this has too often been the case and serious results are certain to follow.

It is to be regretted that the substance of this paper could not be more constructive and less destructive but, unfortunately, this could not be avoided for the proposition as to the disposition of pulpless teeth is not an easy one. It is and has been seriously studied by a large number of men of genius and ability, and as yet no one has been able to offer us anything that is safer than extraction. We recently made a study of a large number of treated pulpless teeth which was convincing in two respects. First, that the evidence is overwhelmingly against poor root-canal surgery, and the second, that which at this time concerns us most is the fact that the evidence is not overwhelmingly against good root-canal surgery. In fact, it is evident that it is not an impossibility to safely treat devitalized teeth, and that we have failed only because we have not as yet a method of treatment that is easy enough of operation to be universally adopted in practice. Then there is but one course for the operator to pursue. That is to play safe and study each case carefully. If conditions are favorable and the skill of the operator is such that a perfect root filling can be inserted, this is certainly the better course. But if conditions are unfavorable and the operator realizes that he cannot do a safe operation, then there is only one thing to do. That is to remove the tooth rather than jeopardize the general health of the patient. For not only the reputation of the individual operator, but that of dentistry is at stake.

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A BIOCHEMICAL STUDY OF BACTERIAL METABOLISM IN ITS RELATION TO CHANGES IN THE DENSER TOOTH STRUCTURES IN THE MOUTH.

(Part 1, Fundamental Basis.)

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(Synopsis: 1. A study is reported of the underlying conditions in the destruction and formation of certain calcareous structures with especial reference to the relationship between bacterial metabolism and the changes in the denser tooth structures in the mouth. In the first (present) part the general fundamental basis, in the light of the accessible facts, is discussed, together with an attempt to indicate the stages and course in calcification and decalcification in the body as conditioned by underlying physico-chemical processes.

2. A fundamental similarity has been pointed out in the formation and general composition of calcareous structures in the body.

3. A regional difference frequently referred to, the effect of bacteria upon crowns of teeth in the mouth, is regarded as a secondary matter.

4. The destruction of enamel of teeth, if an acid dissolution, must proceed at a rate conditioned by the local, NOT GENERAL OR AVERAGE, hydrogen ion concentration and be effected by other factors like aggregation state and surface active forces.

5. Bacteria of the mouth and alimentary tract as well as in artificial cultures are known to be related to the chemical character of the environment and probably to the physical; their metabolism is influenced by the physico-chemical conditions of their environment.

6. The evidence with regard to changes in bone and other calcareous structures, analogous or homologous to teeth, suggest that two possible destruc-

tive changes occur. One is a removal of salts of the alkalin earth metals, the other a removal of the nitrogenous portion. It is suggested that the course of dissolution or decalcification must follow the same laws as formation or calcification but probably in the reverse direction.

7. An attempt is made to aid the investigation by indicating tentatively, the course and stages in calcification and decalcification.

8. A further study, of the changes in hydrogen ion concentration effected by some characteristic oral bacteria and the results of the changes and the proteolytic activities of the same organisms upon the constituents of the teeth, is to follow.—Author.)

I. Introduction.

THE importance of the physical and chemical processes underlying tissue and bacterial metabolism has long been recognized. Until recently, the ideas of the particular transformations in tissues, and especially those induced directly or indirectly by microorganisms, have come thru a consideration of analogous changes in physical and chemical systems. Advance has been made by the application of certain quantitative methods to the study of metabolic processes themselves, instances of which are the studies of agglutination and of immune bodies, of endogenous and exogenous metabolism, and bacterial nutrition. The development of methods to study the role of the hydrogen ion concentration in relation to carbohydrate and protein metabolism and bacterial growth, has added another chapter in this same direction. Information which we have regarding changes in the denser (calcareous) tissues is in contrast to this and it has seemed important to undertake at least an elementary study with regard to the principles involved, especially those associated with bacterial metabolism in the mouth and the changes in crowns of teeth.

The external alterations in the calcareous tissues of the human teeth have been recognized by the dental profession as being of generally two orders: The disintegration of the enamel, one of acid dissolution, and that of the dentin, of a "liquefactive" nature. One difference has been presumed to arise from the chemical composition of the two tissues, the former having practically no organic matter, while the latter has as high as twenty-eight per cent. The studies of Magitot, Miller, Goadby, Black and others have tended to suggest the close relationship of bacteria to both changes; in the former tissue, a fermentation of carbohydrates of the mouth, etc., with the resulting acid formation and acid dissolution, while in the latter tissue, the more or less direct action of the enzymes of the bacteria upon the dentin (organic) substance. Since these ideas are held conjointly with one that the alteration of the coronal tooth substance is in the general direction of enamel to pulp the alteration of the enamel surface would proceed first, that of the dentin after. Opinions with regard to the matter are at variance and with the increase of empirical studies one can hardly draw definite conclusions. With a view to aiding in the better classification of the data which are scattered thruout the literature it has seemed wise to ascertain whether some of the organisms found in the human mouth can initiate in artificial cultures noticeable changes of hydrogen ion concentration, amino-acid-nitrogen and surface tension and whether these changes are of an order such as would pertain to the changes in the mouth and effect solution of the constituents of the teeth. It would appear further that if in artificial cultures certain organisms could or could not alter thru their own processes the permeability or resistance of the enamel layer, or of dentin, and if the same cultures could or

could not split any of the organic substance of bone or dentin, we would be in a position to prosecute further and more important investigations which would throw light upon the control of such conditions in calcareous tissues generally. Certain preliminary work has indicated that available facilities and methods were satisfactory for the study and upon this basis work is being conducted.

Our inquiry will be as follows: Are the fundamental factors underlying the changes in the crowns of teeth in the mouth a consequence of bacterial metabolism, and are they the same factors which condition the deposition and removal of calcium salts in other calcareous tissues or analogous structures? We shall not, for the present, attempt to explain caries of the bone, necrosis, nor the particular forms of various changed calcareous structures. Our concern is rather with regard to the physico-chemical processes associated with the principal changes and the order of events. It seems as tho this is the better course for the present. No attempt at completeness is made, and the frailty of the study is well recognized.

II. *General fundamental aspect of the problem.*

At the present time the underlying factors which govern the formation, preservation and destruction of bone and teeth are imperfectly known. It is not yet clear whether destruction and formation of these tissues stand in a reciprocal relationship. We are hardly able to define caries of the bone and teeth. The question is still open as to whether enamel of the teeth changes in structure or composition after initial formation. Generally speaking, however, the manner of the breaking down of such dense structures is known and roughly divided into two classes, viz. the destruction of the "matrix," on the one hand, e. g. necrosis, and the solution of the inorganic intercellular (or intertubular) substances on the other, e. g. caries. Since, as has been referred to, enamel is presumed to have little or no organic matter, the latter process would with this tissue be only likely to proceed. But the subject cannot be left here. These dense tissues are fundamentally related in being formed by living cells under conditions which normally vary within quite narrow limits* tending to equilibration, in existing in different areas, but again, where the conditions are normally in a state of vital equilibrium, and are composed of substances which in chemical and physical behavior conform to known laws. One principal distinction is apparent and will bear first inspection. The crowns of teeth while generally existing in an environment with a tendency toward an equilibrium where the physical and chemical conditions are not fundamentally different from those in the environment of bones and the roots of teeth, they nevertheless are exposed to the action of bacteria, and are, in this respect, in contrast to the other calcareous tissues in the body. Resting here, lies the common assumption that bacteria are in some way related to caries of teeth, hence the offshoots—"A clean tooth never decays," "The micro-organisms of caries," etc. But the changes in the crowns of teeth have not been satisfactorily explained from this point of view. That some of the changes may be induced by bacterial metabolism is without a doubt, but further consideration of this point indicates that the fundamental processes underlying these changes are due to alterations in acid-base equilibrium, salt balance, surface active forces and ferment—antiferment balance acting independently or conjointly in the mouth and the body tissues and fluids. Since the bacteria are affected by alteration in the acid-base balance (expressed by the hydrogen ion concentration) and their metabolism leads to such a change, it is

*Temperature, pressure, hydrogen ion concentration.

not unlikely that they are related to this aspect of the problem. Since also bacterial action is largely thru enzymes they may likewise make impress upon the ferment—antiferment balance. Alterations in both equilibria would appear to have a pronounced effect upon the stability and functions of the teeth. The relation further of salt balance to all living tissues has been long known to be a close one and we have reason to expect that once the subject is carefully investigated, the stability of the calcareous tissues will in some measure be found to be dependent upon it. A consideration of the relationship between bacterial metabolism and the changes in some calcareous tissues with respect to the hydrogen ion concentration, salts, and the ferments would be materially helpful, not only to understand the true relationship, but to throw further light upon the factors which are related to similar processes.

III. *Composition and structure of, and changes in, calcareous tissues.*

a. Formative conditions.

A brief description of the development of and changes in calcareous tissues in general and those particular ones with which we are concerned at the present time is necessary before we can proceed to study the processes underlying their destruction, since some of the reactions appear to depend upon form, structure and composition. Dense, hard tissues, largely of calcium salts are found in many phyla of the animal kingdom. These vary considerably, even in the same animal. Bone resembles other living tissues in that it grows and is subject to various alterations in the life of the animal. Shells of mollusks, teeth and placoid scales are not fundamentally different in this respect. Development is interstitial with certain modifications, e. g. basilar or peripheral. Calcification is the result of cellular action and it is reversible, differing presumably only quantitatively from ossification and absorption. Osteoblasts or their homologs are generated from the nuclei of tissue cells, have the power of rapid proliferation and are capable of dissemination. These peculiar cells have the power of surrounding themselves with a calcareous zone, or, in certain aggregates, of a calcareous layer on only one cell aspect, e. g. enamel, base of cell columns. At the time of calcareous deposition the cells are presumably mature and assume a fixed form, altho alterations occur thruout life. Shells, and the enamel layer of placoid scales, of tusks and teeth differ from bone in that the formed calcareous structure is finally separated from the ameloblasts.

Sudduth (1) defined calcification as that process by which (organic) tissues become hardened by deposition of salts of calcium in their intercellular substance, as exemplified in the formation of bones and teeth. In embryonal development calcification begins in two forms—ossification and amelification—the first arising from connective tissue cells and the second from epithelium. The essential difference between the two depends upon the matrix, and the manner in which the salts are deposited rather than upon the character of the cells. The enamel substance is deposited upon the already formed layer of the dentin, there being no basis-substance between the layer of ameloblasts and the formed dentin. What is significant here is that a crystallization takes place. This is not true of the interprismatic substance of teeth, of any age, which does not refract polarized light. Dentin, cementum and bone tend to be definitely crystalline and exhibit birefraction.* In bone the matrix is fibrous connective tissue (ossein?). The cement substance between the fibrils is largely composed of insoluble lime salts. The structure of the matrix is similar to protoplasm. The surrounding membranes act as molds and are therefore considered limiting mem-

*Unpublished reports.

branes. In calculi (renal calculi of Rainey) which can be duplicated outside of the body the salts are deposited in a gelatinous matrix (2). Presumably the lime salts in the body combine with the cell components; and probably similar to a combination with albumen or mucilage as in artificial foundations. Artificial structures are soluble in acids, except the matrix, which remains. Rainey, Hasting, Ord and Tomes refer to calcoglobulin. Hasting observed that the treatment of calco spherites with acids changed the former albumen to a substance more resembling chitin "which became exceedingly resistant to the action of acids, alkalies and boiling water" and to the organic compound gave the name calco-globulin. Bone, Sudduth maintains, "is simply an aggregation of calcospherules" first thrown out as a thin covering of the osteoblasts. "The wall," he continues, "is thickened at the expense of the size of the osteoblasts." Since the osteoblasts are in contact with each other at the start it is not difficult to trace the formation of the fibres. The connection between the bone cells is, however, not understood. The subject of ossification is now divided into "interstitial," "intramembranous," "subperiosteal" and "intracartilaginous," depending upon the type of laying down of calcium salts. The cells which form these tissues are all osteoblasts.

Sudduth holds that fixed connective tissue cells are only modified white blood corpuscles; the osteoblasts, the ordinary embryonic connective tissue cells. These are in intimate contact with the vascular supply. The building up and breaking down appears to be due to functions which are common to the white blood corpuscles.

Cementification is a modified form of subperiosteal development of bone. The thickening of the cement is from the first layer deposited upon the dentin, enlarging the circumference. The pericementum is analogous and continues with the periosteum.*

The formation of dentin is referred to as tubular ossification or dentinification. The first-layer dentin is a permanent product. The odontoblasts are modified connective tissue cells, situated at the periphery of the pulp and send out rod-like processes to the inner side of the enamel organ in the crown. Dentin is formed by the mature cells around the dentinal fibrils. The thickening of the tissue is by the accretion of lime salts, lengthening the tubules and thus forcing a recession of the pulp. The dentin is deposited first at the apex of the dental papilla, gradually widening in area and thickening while the odontoblasts are proliferating rootward. Mature dentin is a solid mass of calcified tissue, the tubules gradually becoming cemented together as a solid. The occurrence of interglobular spaces in dentin are held to support the notion that "the dentin is secreted into a protoplasmic basis substance." The spaces are presumed to be masses of calculo-globlin not fully calcified and are pierced by the dentinal tubules. Manning (3) reports he has demonstrated semipermeability in dentin sections 0.25 mm. thick.

The enamel is deposited or secreted from lower, deeper ends of ameloblasts. The amount of organic matter in enamel is less than in analogous structures of mollusks. An interesting point yet to be investigated is the apparently different composition of the secretions from the lower side of ameloblasts and from the upper, respectively, as in enamel and shells. Sudduth and others are inclined to believe that the early enamel does contain some protoplasm in physical or chemical association with the lime salts. The interprismatic or fixed material of shells is known to be insoluble in acids and is rendered more insoluble by their action (generally spoken of as a hyalin

*Function of Periosteum, cf. Keith, British Jour. Surgery, 1918-19, and MacEwen—Growth of Bone.

formation). The interprismatic substance of enamel is dissolved by dilute chromic acid allowing the prisms to fall apart unchanged. This type of destruction is not known to occur in the mouth. The prisms are hexagonal—thru intra molecular pressure (?)—and match the interdigitation of the forming cells. Wave lines in the prisms according to Febiger are due to inequalities. Bödecker claimed that "the enamel is built up of columns of calcified substances between which spaces exist." Eckermann and others have shown that the depth of staining of enamel increases with the age of the tooth; apparently indicating that the interprismatic substance undergoes alteration with age. The interprismatic substance often called "cement" is not uniform in thickness and has often been regarded as an active protoplasmic network. Bödecker believed it to be continuous with the dentinal fibrils. Klein believed that a homogeneous interstitial substance exists and that this was larger in amount in the immature than in the fully formed tooth. Sudduth points out that the first formed layer of enamel is deposited in more or less protoplasm and immature developing enamel may be decalcified, leaving a matrix. In the first formed layer the dentinal fibrils appear to interdigitate with the enamel prisms. Points or spaces sometimes occur in enamel which Sudduth believes are filled with calco-globulin. Where these occur upon the surface they lead to pitted and grooved points. This fixed material is dissolved out by soluble ferments and apparently insoluble in the ordinary acids of the mouth. Mrs. Whitman and Sudduth have noted that in the last stages of amelification the ameloblasts undergo an alteration. In growing teeth, near the last stage of enamel formation, the ameloblasts change from columnar type to flat horizontal cells on all the areas except near the neck, and a sort of cuticula appears, "a perfectly homogeneous membrane." Apparently the oldest enamel-forming cells undergo a metamorphosis. After the individual prisms, which are each the work of a single ameloblast, are formed, the outer layer of enamel is deposited by the transformed membrane. This membrane, known as "Nasmyth's membrane," is hence a metamorphosed ameloblastic layer. The "cortical layer" of enamel is deposited by this membrane; a layer analogous to the "nacreous" layer is found in shells. Mature enamel varies in hardness from specie to specie and apparently from tooth to tooth. Pickerill (4) found that the surface resistance was variable. Such variations are seen in shells. Carpenter is quoted by Sudduth as follows: "This (increased) hardness appears to depend upon the mineral arrangement of carbonate of lime." (p. 603). Interprismatic matrices have seldom been reported by histologists and the idea has been generally discounted. The enamel is regarded generally as a "coat of mail," only protecting the dentin. Rickert and Bunting (5), Gies (6) and Eckermann (7) have shown that the enamel serves as a boundary membrane and permits the diffusion of solvents and some salts. The surface is generally polished but varies. Its thickness generally decreases to the neck of the tooth, and the developmental grooves of the molars and bicuspids. Some differences have been pointed out in chemical composition of the enamel layer between different races and the sexes. Sudduth, referring to Von Bibra's analyses, speaks of a difference in organic material of the enamel in men and women. One infers from his statement that the resistance of the tooth to acids of the mouth varies in proportion to the organic constituent, but this should be more carefully studied. The enamel changes have in part been attributed to dessication, an increase in the hardness and decrease of interprismatic substance. Alterations in molecular structure of crystals thru loss of water of crystalliza-

tion is known and has been considered analogous to the changes in the enamel. Pigmented enamel is known and may be induced thru madder root ingested with the food or with trypan blue when the teeth are being developed. The pigmentation occurs in bands or striae. Mottled enamel has been studied for some time (8) and appears to be an alteration in the interprismatic substance. With the death and other changes in the pulp some pigmentation occurs. Differences in structure of the enamel layer have only partially been correlated to faulty calcification. One of the experimental attempts to show the influence of diet on teeth formation and also on eruption is that of Mrs. May Mellanby (9). Types of hypoplasia she writes "characterized by bands of defective enamel have been traced to specific fevers or to some acute illness as regards the more generalized types of gross hypoplasia. The parts of the teeth usually affected point to some cause acting during the first two years or so of life." Mrs. Mellanby found with reference to this malformation, as the results of experiments with puppies, that the abundance of articles with which the "fat-soluble A accessory-food-factor" is associated allows the development of sound teeth. Deficiency in these substances is associated with delayed loss of deciduous teeth, to the delayed eruption of permanent teeth, irregularity in position, partial absence of or defective enamel, and low calcium content. She further points out that "this is an instance of diet affecting teeth from the inside and is independent of bacterial sepsis and other oral conditions associated with food." She does not consider that the conditions can be attributed to malnutrition nor acute illness in her experiments since the improvement by addition of fat-soluble A "is as characteristic as the deleterious effect of deficient diet" and also that "the defective teeth are most pronounced in the rapidly growing puppies, and it is difficult to associate rapid growth with illness or malnutrition as generally understood."

b. Post-formative changes and relation of bacteria to them.

It is undoubtedly significant that the formed enamel is exposed to less constant conditions than any other calcareous tissues. Post-formative changes in calcareous structures have been more especially studied by the dental profession but the underlying principles have been largely overlooked. That acids act destructively upon these structures out of the body has long been known. Certain difficulties in conception have, however, grown up which have led to lengthy discussions without great profit. The fact that usually the mouth is neutral and that the saliva, like body fluids and tissues, does not change from neutrality for long, was an apparent inconsistency. The character of dental caries with respect to location and duration has further had varying effects upon an acid dissolution theory. The demonstration by Miller and others some years ago, that bacteria from the mouth produced lactic acid among other substances and that the tooth crown is apparently soluble in this acid, was more favorable and has since been accepted with various qualifications. Many of the post-formative changes of enamel, e. g. caries, are generally periodic. The subject is at present in an unsatisfactory state. Certainly means have not been established for the control of the condition; and if bacteria are the cause, say some, why can we not overcome them? We are probably in difficulty because of a lack of definite ideas regarding the underlying physical and chemical processes and the limiting ratios.

c. Analogous changes: Tricalcium phosphate and bacterial metabolism in soil.

Since Hopkins and Whiting (10) (referred to by Hinkins (11) demon-

strated that tricalcium phosphate (one of the components of calcareous tissues) is altered thru bacterial action in the soil, the chemical changes involved have been made more clear. In the soil where conditions are somewhat similar to the mouth, e. g., a colloidal aggregation and a generally alkalin or neutral environment, they found that there may be acid production at local points. Their investigation indicates that tricalcium is changed to dicalcium or monocalcium phosphate. This may occur thru the relatively strong nitrous acid, the weaker acetic, butyric and lactic acids, or the still weaker carbonic acid. These acids are all produced thru bacterial action upon various proteins, sugars, starches, fibers and other compounds. It is significantly pointed out by Hopkins and Whiting that "in the first stage of decomposition it has been impossible to measure any soluble phosphorus without the growing plant as an indicator." A brief summary of their study may be of value, for in a number of instances it illuminates our problem. They point out that the decay of organic matter is not brought about by one kind of bacteria only, nor the result of but one process. Ammonia production and acid production occur at the same time as carbon dioxid production; in manure piles with raw rock phosphate present, and nitrate being produced, the general reaction may be alkalin. Further, the growth of bacteria depends upon specific compounds. In the presence of moisture and ferments, oxidations are carried out, the acids tending to be produced and requiring neutralization to the optimum bacterial needs. There tends also to be a utilization of calcium and phosphorus by the bacteria. The bacteria, after dissolving the phosphate, by subsequent action on the solution, make some of the phosphorus insoluble again, possibly by utilizing it for growth. Bacteria which utilize nitrites are principally involved in the phosphate change, whereas nitrate bacteria are not. Carbon dioxid is produced in considerable quantities by bacteria and in carbon-dioxid-saturated soils some raw rock phosphate can be found in a soluble form. It is to be noted there that the general impression of dentists is that the acids and other substances produced by bacterial action on the saliva and food remnants are an important element in the decay and corrosion of teeth, or in the deposition of the tartar on the teeth. It is not impossible that, as indicated by Hopkins and Whiting's studies, the calcium phosphate of the teeth will neutralize the acids (a so-called "buffer action") produced by the bacteria and become more soluble. Whether this action favors the direction of caries toward the pulp, on the mesial and distal surfaces, and often on teeth where salivary calculi are being deposited remains for the present unanswered. It is beyond doubt that there tends to be in the mouth an acid-base equilibrium but what its relation is to true neutrality and whether the phosphates of the saliva and those of the teeth aid in its maintenance or only the latter, is open to experimental investigation. It is likely, however, that the reactions involving the formed tooth and bone structures must follow the general laws of solution, diffusion and precipitation and be effected in various stages.

IV. *Bacteria of the mouth and alimentary tract.*

It will now be important to refer briefly to the facts regarding bacteria in association with the tissues such as we are studying. With reference to bacteria Vignal found microorganisms in healthy human mouths as follows: Out of the nineteen, ten dissolved fibrin; nine, gluten; ten, casein; five, albumen; nine converted lactose into lactic acid; seven inverted cane sugar; seven caused fermentation of glucose; seven coagulated milk. Sanarelli showed that normal saliva destroyed the vitality of a limited

number of pathogenic bacteria—B. typhi abdominalis and S. cholerae asiaticae. Kligler (12) using as a basis in disease the clinical diagnosis of the single tooth with respect to its flora and in health the more general conditions, found the flora generally the same in character, streptococci and cocci predominating. The prevailing flora on "healthy teeth is approximately the same in all cases." He found an increase in the total number of bacteria during the night and during and immediately following a meal. With "diseased teeth" there was a decided difference in the numbers of bacteria present at the different stages of decay, with a complete change in the character of the flora and the relative prevalence of types from that of the healthy teeth, with a further difference between the types of bacteria in the early and later stages. It appeared to Kligler that "the early stages are due to one and the same process, characterized by a great decrease in the total number of bacteria accompanied by a drop in the relative number of cocci and a marked increase in the number of acidific bacilli and thread-forming organisms." He recognized the difference in decay of the pulp from that of the enamel and dentin and that there was an association with changes in flora. Studying children alone, Howe and his assistants confined their attention to the flora of carious teeth, especially the six and twelve year molars. They found principally members of the Moro-Tissier group. Members of this acidific group were always present, and it appeared to the investigators that the acid-forming properties limited the character of the flora in the carious tooth. Gillette and Howe (13) have shown that "as far as aerobic microorganisms are concerned the number of bacteria in the mouth are directly proportional to the amount of deposit present, regardless of the presence of caries." "The difference between the flora of immune and carious mouths appeared to be qualitative with a predominance of organisms capable of producing larger quantities of acid when caries are present than when there are no caries."

Meyer (14) reports that Brailowsky-Lounkervitch (1915) has demonstrated apparently that a notable change in distribution and frequency of flora occurs with dentition. The buccal surface and palate, gums and tongue have apparently marked differences. The observation was made that the bacterial flora of a clean mouth, on account of alkalin or neutral reaction, is aerobic or facultative anaerobic and poor in proteolytic organisms, in contrast to a dirty mouth.

The absolute statement of bacteria in the mouth, or even the ratio of microorganisms to unit of saliva, or debris, or tooth substance is, however, subject to later qualifications. We are really interested in the "working residue." No matter, e. g. carbohydrates in the mouth, can be changed without *relative* increase in one agent, say the bacteria, or a *relative* decrease in another, say the substances which tend to inhibit bacterial growth, and, since we are dealing with physico-chemical processes, the reaction must proceed thru a certain period of time. The buccal cavity is continually drained, its concentration of various agents is fluctuating, tending toward an equilibrium. The substances which give rise to bacterial growth, those which inhibit them, the bacteria and their metabolites are in an ebb and flow.

We have learned (15) that no less than five to eight grams of bacteria, dead for the most part, are excreted every day with the feces, and that the character and quantity of bacteria bear a direct relationship to the food digested. It now appears that lactose and dextrin with meat and rice cause a marked development of aciduric bacteria of the b. acidophilus type, predominating the fecal flora, tending to suppress the proteolytic types. Glucose, maltose and succrose cause either none or a minor alteration.

These results persist as long as the diet is maintained. Starchy foods tend to induce elimination of the obligate putrefactive bacteria, while proteins vary in their effect. Milk casein has a less tendency to give rise to putrefaction than meat protein. Fats and vegetable proteins are either without determining influence or stand in contrast to meat proteins in the encouragement of putrefaction. Milk led to a variation in the intestin from B. coli and streptococci in unboiled, to streptococci and B. acidophilus in boiled milk. Torrey correlates the types of bacteria vegetating in the intestinal tract to the chemical character of the food ingested. As secondary controlling factors he indicates the rate and degree of digestion and absorption of the food and the character of the end products. It excites considerable interest to read that in both the intestin and carious teeth, B. bifidus and B. acidophilus predominate (compare Howe, Kligler, Meyer), presumably under similar chemical conditions and in relation to the chemical character of the food.

V. *Bacterial metabolism.*

We are now interested in the question: What is the relation of bacteria to their environment, chemically? Bacteriologists have found that certain amino acids are utilized by different groups of bacteria and that some, more complex, products may be split. It has long been known that gelatin is liquified by certain organisms. Berman and Rettger, (16), Itano* and others have shown that b. subtilis is able to break down protein in the presence of fermentable sugar and in absence of a "buffer" (a substance like carbonates, phosphates, amino acids, which "soak up" excess of hydrogen or hydroxyl ions). The organism attacks glucose slowly and for this reason is able to produce a proteolytic enzyme before its activity is checked by the hydrogen ion concentration. B. coli in a glucose or lactose medium with utilizable nitrogenous substances available maintains a suitable hydrogen ion concentration without the aid of a buffer. In this case the nitrogen metabolism neutralizes the acid formed from the sugar decomposition. Berman and Rettger suggest three types of bacterial metabolism—one where the organism attacks protein in the presence of fermentable sugar, because the sugar is fermented slowly and the nitrogen and carbohydrate metabolism are maintained in equilibrium. The second type is where the organism is able to regulate its own environment with a rapid sugar fermentation where little acid occurs among the end products. The third type is where sugar fermentation is rapid with the formation of large amounts of acid. With the last type, acid production tends to prevent further metabolism. Buffers like dipotassium phosphate tend to prevent such inhibition. These authors observed that a bacterial proteolytic enzyme is not as a rule produced within the first twenty-four hours. Previous to this some building up of bacterial substance (anabolism) must take place unless some enzyme is transferred with the organisms. With reference to their experiments they found that fermentable sugars in moderate amounts do not affect the nitrogen metabolism of bacteria in an otherwise fermentable environment. In confirming previous experiments they found that the bacteria require food substances of simple constitution and readily absorbed by the bacterial cell. Their conclusions were that bacteria are unable to decompose coagulated native protein in the absence of other sources of available nitrogen; that the purified proteose is resistant to direct action by bacteria; that gelatin and casein resemble proteose in their resistance to bacterial attack; and that the ability of an organism to liquify gelatin does not necessarily indicate that it possesses proteolytic properties. It is recognized that the enzymes

*Itano, Mass. Agric. Coll. Exp. Sta., 1916.

of B. subtilis and proteus vulgaris types are similar in their action to the pancreatic digestion of protein. Their bacterial enzymes appear to rapidly cleave some proteins, forming similar products to those in tryptic digestion. We also know that all organic matter is not food for bacteria but that it must be of simple composition before being utilized. It seems then that similar to other living cells, bacteria construct their own substances of these simple products. The body fluids or tissues apparently contain or provide the simple nitrogenous substances suitable to bacterial anabolism. Amines and amino acids are undoubtedly present.

A number of investigators have reported significant variations in the growth of bacteria with respect to temperature and other factors. These are referred to respectively as stationary lag, logarithmic growth, negative growth acceleration, stationary growth, accelerated death phase, and logarithmic negative growth (17 and 18). Rettger (19) points out that the so-called bacterial lag is likely a temporary absence of the substances which are necessary for bacterial growth in the new environment to which the organisms are transferred. Satisfactory culture media which practically eliminate bacterial lag would have the necessary simple intermediate bodies and possibly growth accessory factors. Salter found that bile salts, peptone up to 5%, beef extract, dipotassium phosphate up to 1%, and the age of the culture influence the rate of growth, with b. communis.

VI. *Special considerations regarding relation of bacterial metabolism to changes in calcareous tissues in the mouth.*

a. Aggregation states.

This general survey now leads us to a discussion of another grouping of the evidence with respect to the formation or destruction of calcareous tissues and bacteria generally. We have seen that the osteoblasts are similar in function to the white blood corpuscles; that bone formation, cementification and dentinification are alike in principle and differ from amelification only by reason of the enamel being finally separated from the secreting tissue; that bone, dentin, cement and enamel are subject to many (but similar fundamental) influences in formation. The enamel during development may be related to accessory food factors; and appears to increase in density later; and probably calcareous tissues, generally, tend to be affected likewise. We have seen that bacteria are related to an acid-base balance, are generally affected by the changes in hydrogen ion concentration, produce acids thru their metabolism, and in the soil at least, change tricalcium phosphate to monocalcium phosphate. The bacteria of the mouth appear to fluctuate, with a tendency in health and disease, respectively, to a constant flora; that the bacterial groups change in accordance with definite conditions, notably a fluctuation with changes in dentition, and decrease in total numbers at the early stages of decay with a rise of acidific bacilli and thread-forming organisms; and that there appears to be a characteristic flora of carious teeth. The flora of the alimentary tract appears to change in character and quantity in relation to the chemical character of the food as indicated by conditions in the intestine and the mouth, with a distinct tendency to the survival of certain groups. We have further learned that bacteria utilize amines and amino acid nitrogen; that their metabolism is related to temperature, carbohydrates and salts in solution; that, with certain exceptions, they do not cleave gelatin, casein and proteoses; that liquefaction of gelatin by them is probably not a splitting but a gel to sol transformation; that their enzymes may not completely decompose substances like glycoproteins but may cleave glucose from the molecule. It also appears significant

that bacterial growth is periodic; that bacteria require definite time, as well as other factors, for changes in structure and composition. In sum, we realize that the stability of the calcareous tissues and the bacteria is dependent upon (1) environment, (2) specific cell composition and structure, and (3) cell or tissue functional activities. Growth, repair and destruction of most living processes seem to be fundamentally related to the environment with respect to the acids, bases, salts or their ions and probably physical forces which we shall later examine in certain quantitative relations.

Among the physical and chemical aspects of our problem, the state of aggregation is important. The growth of the calcareous tissues appears to depend upon the state of solution of the calcium salts; the stability of the bone and teeth, upon the peculiar conditions of the solid state in contact with other solids, liquids and gases. The condition of and some of the changes in the teeth may be explained on the basis of dilute solid solutions. The matter is open to investigation but at present is little understood. The observation that solids, such as we are dealing with, conduct electrolytically suggests solid diffusion; and diffusion thru plates of calcium salts may be explained thru transport of ions since the two stand in intimate relations. Some of the phenomena, however, appear to be typical of alterations in colloidal solutions. The condition of most of the fluids in the body is analogous to suspensoid sols. This is true of the blood and lymph and it appears to be true of the saliva. Chemical reactions in the body are characteristic of those in colloidal suspensions. In fact it is upon the properties of colloids that the cell functions depend. The precipitation of mucin and agglutination of bacteria, and likely solidification of calcium salts in the body, for examples, may be explained by the play of surface active forces, ions and various salts in colloidal solutions. The true explanation of the transformations of the calcareous tissues will not be forthcoming without consideration of the aggregation states. This must be borne in mind as we consider the various physico-chemical processes which underlie vital phenomena.

b. Hydrogen Ion Concentration.

The work of L. J. Henderson in making more clear the mechanism of moderating the hydrogen ion concentration in protoplasmic processes has had a pronounced effect upon studies of changes in the living cells or those related to their growth. The various processes taking place in the living organism are known to be very sensative to changes in the acidity and alkalinity, and some processes result in the production of acids or bases, as referred to in the case of bacterial growth. The numerical values of the concentration of hydrogen and hydroxyl ions serves to express the true condition. The increase of hydrogen ion concentration is known to be taken care of partly by removal of CO_2 in respiratory ventilation, and lactic acid by oxidation in the blood tissues, but other means are provided, e. g. bicarbonates and carbon dioxid; the acid or alkalin phosphates; proteins, as amphoteric substances; and adsorption (altho probably a subordinate factor in the equilibrium process). It is important to mention here the properties of the hydrogen and hydroxyl ions. One may well recall the fact that some acids will turn out others from combinations and some solutions of them invert solutions of cane sugar more rapidly than others, in the same relative concentration. The common character to acids is the hydrogen ion, and to bases, the hydroxyl ion. The alteration of litmus and phenolphthalein depends upon the relative concentration of these oppositely electrically charged ions in solution. The great activity of hydrogen and hydroxyl ions in physiological processes is undoubtedly in many cases connected with the relatively great rate of migration, which is affected by

the state of aggregation and viscosity of the solution. Very small concentrations of H^+ and OH^- have pronounced effects on colloidal solutions. Faraday's original work (1858), with that of Schultze (1882), Hardy and others, relate the electrical charge of the ions to observed effects upon colloidal states, e. g., coagulation, precipitation, etc. The activity of enzymes (cf. Bayliss and others) appears to be due to the colloidal state and changes in the hydrogen ion concentration (expressed frequently as pH). To similar changes we know the heart is effected, and the respiratory center lies in a still more sensitive class. (cf. J. S. Haldane and Y. Henderson.) Bacterial metabolism, as we have seen is affected by changes in pH. Working with b. subtilis, Itano, for example, found its activity to be greatest at pH=7.5 to 8.5, to stop below pH=4.18 and above pH=9.43. The optimum concentration for proteolysis in the cases of Streptococcus erysipelatis and S. lacticus was pH =7.62 and 7.02 respectively.*

c. Salt content.

Beside the hydrogen ion concentration in importance, stands the salt content of the medium in which sells are living. The blood, lymph and saliva contain, at least, salts of sodium, potassium and calcium in quite definite ratios. In fact few, if any, living processes go on in the absence of these salts. Generally speaking the salts of the univalent ions are antagonized by traces of a salt with a bivalent cation. (Osterhout, Loeb and others.) The work of W. J. V. Osterhout, J. Loeb, and R. S. Lillie especially has indicated the relationship of these ions to the alterations in the semipermeability of membranes of living cells; but Clowes' work has shown the significant structural analogy in the alteration of emulsions of oil and water. Loeb (20) it was who expressed the "theory of physiologically balanced salt solutions, by which we mean that in the ocean (as in the blood or lymph) the salts exist in such ratio that they mutually antagonize the injurious action which one or several of them would have if they were alone in solution." We have previously referred to their role in the maintenance of neutrality of organisms. We shall later point out the relation to solution and precipitation of solids.

d. Surface tension.

In transformations, such as must occur with reference to the dissolution of calcareous tissues, the growth and activity of bacteria and the functional activity of secreting cells, surface tension phenomena are to be considered and as well, in the former case, solution tension and sublimation tension. In the last few years since the work of Macallum has been brought to our attention and, later, the work of Madsen, Jorgensen and others in the field of agglutination, the role of surface tension in its relation to vital phenomena has served to acquaint us with some of the mechanisms involved in cellular function. Before the work of Macallum, surface phenomena had attracted the attention of physicists and chemists. The surface contact between a liquid and another phase (solid, liquid or gas) had come to be recognized as differing in many characteristics from the properties of the main body of either phase. Laplace showed that the surface tension has its origin in the forces of attraction between the molecules of the liquid. The surface energy was found to vary with the chemical nature of the liquid, some solutes acting to lower the surface tension, while some increased it. It later came to be recognized that substances which lower the surface tension tend to move to the surface, i. e., "Gibbs-Thompson law." The so-called adsorption phenomenon is really surface condensation and may be mechanical, elec-

*Explanation: The concentration of hydrogen ions in neutral (pure) water where $H_2O=H+ + OH-$ is 1/10,000,000 molecule in grams, per litre of solution; that is, 0.0000001 "normal" or $1x10^{-7}$ (H+) which is expressed as pH=7.

trical or chemical. Rather rigid films are formed according to Ramsden with saponins, proteins, etc., and in these may be dissolved substances in a different concentration from those in the interior or main body of the phase. Chemical reactions which lower chemical potential are favored at a surface and the rate of these is controlled by the extent of the active surface. The phenomena characteristic of colloidal solutions are presumably the results of acting surface forces, that is, forces at play at boundaries. No direct application of the surface tension formula has been applied to the formation of bacterial films on the surfaces of teeth nor to the changes which appear to take place at the tooth-saliva boundary. It is undoubted, however, that the crown surface is always wetted by saliva, hence the forces which act at the tooth-saliva boundary are different from those which act in the saliva or in the body of the tooth. Since the tooth is electrically charged and the saliva is a suspensoid colloid (likewise charged), it is further probable that there is a tendency to surface adsorption. Pickerill appears to doubt this, altho he admits that the staining of teeth may be an adsorptive phenomenon. If it is later definitely established that the enamel is permeable or semi-permeable, which has been suggested by experiments of Gies (6), Eckermann (7) and Bunting (5), it may be that ionic phenomena there are analogous to phenomena observed by Bartell and Hocker (21) in clay partitions. The electrical charge of the saliva-half of the double layer may be due in part at least to hydrogen ions and the anode side (saliva) becomes alkalin; the cathod side (enamel), acid. It is also to be recognized that the hydrogen ion exerts an influence; on the positive sol opposed to precipitation, acting opposite to that of the hydroxyl ion; vice versa, of course, in the case of negative sols. Any solution or precipitation of solid particles would be expected in our case to be in accord with these phenomena in colloidal solutions. Precipitation is due, if we may draw upon the work of Bodländer and others, to a balance between the two opposing influences, that is, the action of ions of opposite sign (isoelectric point). Whether or not reversible precipitation occurs at the tooth-saliva boundary is not yet known. The formation of salivary calculi and caries on the same tooth tends to suggest that in local regions, particularly, the opposite is true. The work of Clowes and Bancroft (22) may be mentioned here since it tends to offer an explanation of the distribution of calcium in surface films. They found that the solubility of calcium salts in the oil phase and of sodium salts in the water phase of oil-water mixtures affected the surface tension of the oil-water boundary. It is only significant here, perhaps, that the ratio of calcium to sodium as far as the ions are concerned is important in determining whether oil is suspended in water, or the reverse, or neither; and the dispersion of Ca soaps in oil more than in water, and the tendency of these ions to move toward the surface. If this be true, and it may be experimentally investigated, we may better understand the solution and precipitation if calcium salts under such conditions as exist in the body.

e. Sublimation and solution tension.

We are more likely dealing with the solution tension and sublimation tension in the dissolution of the enamel and the solid calcium phase of dentin, cementum and bone. The composition of the structures suggests an equilibrium existing between two or three solid phases and a different pressure of their vapors, the pressure of which is called "sublimation tension". This tension, which would appear to exist in the case of the enamel and calcareous structures must be altered before chemical reactions would proceed, since the complex salts must dissociate into their less complex relatives and the chemical reactions follow in the vapor

phase surrounding the solids. This cannot be conceived to take place except thru an alteration of the phase boundary conditions and decrease of the electrostatic force which holds the oppositely charged ions together in the solid phase. Now a solid in contact with a solution, e. g. teeth bathed by saliva, tends to send off its molecules so as to form a solution. This tendency, exerting a so-called solution pressure, is affected by the concentration of the ions in the solution. As the ions of the same kind in the solution are increased, their osmotic pressure opposes the passage of similiar ions from the solid, and as the ions leave the solid, or are deposited upon it, it will become charged respectively, negative or positive.

VII. *Physical chemistry of calcification and decalcification.*

Unfortunately we have, in detail, no accurate picture of the composition of the calcareous structures, nor of the mechanism of the deposition and solidification in bone, teeth and shells. We have, from histological and embryological sources, mainly, only a rather vague idea of the structure of enamel at various stages of formation. It is suggested that this can be improved upon thru X-Ray studies and the application of optical petrographic methods as applied in crystallography. As regards calcification and decalcification we are far from having a clear understanding of the stages and the course or courses of the general process. To aid in this study a statement of the author's conception is given. The author believes that calcification, fundamentally, is the inverse of decalcification, in the living body, occurring under conditions not unlike those outside of the body, where solids arise from colloidal solutions as the result of (1) alterations in surface energy at phase boundaries, (2) the alterations in the ion or solubility product, thru infiltration, hydrolysis and synthesis, and (3) alterations in the hydrogen ion concentration. The outline which follows is of course tentative and will be considered later in connection with experimental results. It is but a preliminary step and is unsatisfactory. A view of calcification as related to CO_2 content is presented by Wells, and will be referred to later; but this does not appear to provide an explanation of some of the changes in the formation of bone and tooth structures which are frequently observed.

Structurally, bone, dentin and cementum may be placed in one group, enamel and shells in another. The difference between the two groups chemically lies in the relative amounts of nitrogen and carbon to calcium and magnesium. Bone, teeth and cementum differ from each other slightly as regards chemical composition and more as to the method of formation or growth and the histological form or structure. As solids (physically), the masses in mature organisms differ little from each other—tend to approach an ossified mass, more or less crystalline, with little protoplasm in the formed structure. This is least true of bone. In the second group, enamel differs from mollusk shells in being secreted from opposite faces of the ameloblasts, with less nitrogen and carbon than the latter, and a thinner, less permanent, "nacreous" layer. The enamel is not uniformly crystalline at least insofar as separate prisms can be viewed in plane polarized light along their short axis, and the interprismatic substance is apparently amorphous.* The crystallographic structure should be carefully studied to illuminate this and other structural questions and also to throw light upon phenomena, which appear, under various stresses, e. g. sudden alteration of temperature, friction and pressure, as electric currents. The much belabored problem of "sensitivity" of the dental structures may be cleared up thru a physico-chemical crystallographic investigation. Pyro-electric currents in

*Unpublished reports.

crystalline structures are well known. Of the minute structure, then, our knowledge is not satisfactory and especially with respect to the structural alterations in relation to changes in the body tissues and fluids.

Observations upon forming bone, teeth and shells indicate that the solid structures arise out of a gelatinous mass, but the composition of the mass is uncertain and its subsequent modifications are not clear. The following outline is drafted from the histological evidence and reactions of a chemical and physical nature in colloidal systems. Two formative courses suggest themselves which could give rise to calcified structures. We may consider in the first that the stages are as follows:

I. Secretion by cells of a substance which is, or gives rise to, a gelatinous (colloidal) mass.* (1) The alkalin earth salts** may be present in solution as intimate radicals of a protein or lipin (discontinuous phase); or (2) in solution, distributed between the discontinuous and continuous phases of the mass. Calcium is at least more soluble in lipins and proteins than in water.

II. The formation of phosphates and carbonates thru hydrolysis and molecular action in solution; and separation of the solid phase.

III. Solidification and crystallization.

A second view (which in part has been suggested by Williams (23) and perhaps others) is similar to the first except that

I. Secretion of gelatinous substance is without the alkalin earth radicals and dissolved or adsorbed ions which are

II. Diffused later as soluble salts with subsequent rise of phosphates and carbonates and then, as before,

III. Solidification and crystallization.

The secretion of the mass from which arises the solid structures does not appear to be different with respect to each special structure, i. e. bone, dentin, etc. Aggregations of secreting cells in layers are more or less intimately connected with a limiting tissue such as the periosteum, altho as Macewen and others have shown, in diaphyseal bone, that epiphyseal plates will give rise to bone free from periosteum. The secreted mass assumes a definite form in consequence of the proliferation and extent of the limiting tissues. It is not unlikely that the ameloblastic layer in enamel formation and the forming enamel serve, coronally, as a form governor, as the pericementum does with respect to the root. The growth of the structures is similar. In bone, cementum and mollusk shells the structure appears to be deposited periodically, that is, laid down in waves; but the true significance of laminations in bone and cementum, in apparent contrast to dentin and enamel, remains to be studied carefully.

The order of secretion, salt formation, saturation and solidification is indicated by events observed in the body and in physico-chemical systems. The peculiar form of the structures is undoubtedly related directly to the cells and their aggregates, but the mechanism of the secretion, and subsequent changes in the intercellular mass does not appear to depart from processes occurring outside of the body. Since we have presumed that the mass arises as a consequence of cellular functions the properties of cells must be considered. It is not unlikely that the gelatinous mass which has been observed in early calcification is but transformed protoplasm. A number of secreted body juices have been considered in this light. Saliva appears to arise as the result of cellular synthesis. Raw material brought to the cells thru flow of blood to the glands is made into crude

*Called crudely "calcoglobulin," but further than this, undefined.

**$CaCl_2$, CaF, $CaCO_3$, $Ca_3(PO_4)_2$, $MgCO_3$, X $MgPO_4$ have been cited in such combination.

protoplasm; later, thru unknown processes, giving rise to mucin and other constituents which accumulate in the cells and then is secreted from their inner ends, as saliva. It is not to be overlooked that many of the salts with which we are dealing in calcification form, on precipitation outside of the body, gelatinous-like masses. In the light of cell reactions generally, solidification of the mass would occur outside of the cells and in areas away from the cell boundary. It is not known whether the phenomenon is like gelatin or petrifaction. It is not unlike some crystal and rock formations. Crystallization often occurs but amorphous masses and nitrogenous constituents are also present. This may occur independent of the cells but it is nevertheless intimately bound up with and is thus practically a part of the cellular functions. Evidence which we have indicates that during the life of the cells the structures are affected only thru them. Calcification thus usually proceeds or recedes thru the metabolic activity of the forming cells and any processes which affect cell metabolism would leave their impress for the time being, at least, upon the secreted mass. We have, however, come to recognize that cellular metabolism is affected by alterations of a physico-chemical nature and in the secretion of the bone, enamel, etc., we are fundamentally dealing with physico-chemical phenomena, resembling reactions in colloidal systems. The building stones brought to the cells are transformed by hydrolysis and synthesis, oxidation and reduction. The intake and outgo in cells resemble diffusion. Calcification may resemble precipitation and solidification; and decalcification, resolution. If such be the case, we thus would expect to observe the influence of surface active forces at phase boundaries, the effect of antagonistic ions, e. g. Ca:Na, the effect of the hydrogen ion concentration, and in our particular case the ion or solubility product. It is not improbable then that the conditions under which a substance, once formed in the body, may be dissolved or precipitated* and may move toward a liquid-solid boundary or away from it, are similar within and without the body. Hence while we regard the formation of bone, etc., as a cell phenomenon, we must not neglect the physical and chemical conditions determining the process.

There is some evidence that decalcification is effected thru cell metabolism. Presumably in this event there is an unstable equilibrium between the cell content and the nutrient plasm. As the concentration of constituents of the nutrient plasm rises and falls, the concentration of the cell would be expected to follow. Since the cytoplasm tends to be in equilibrium with the interstitial medium, the secreted calcareous mass would be noticeably affected if the circulation to the cell were interfered with beyond a certain limit. In cases of caries of the bone, rachitis and osteomalacia, the reduction in calcium content is often temporary; and circulatory disturbances have been considered. If our suggestion is correct the bone cells would be altered temporarily because of a change in equilibrium conditions. Many changes in calcareous structures, however, also appear to be effected thru cell metabolism In necrosis the nitrogenous matrix of the bone is involved, whether thru autolysis or not, is not known; the cell circulation is usually cut off and the nitrogen content (not the calcium) is affected. From our point of view an equilibrium tends to be maintained. Hence when the circulation is interrupted the cells draw upon the secreted material which, next the cell is probably still in a gelatinous stage. Resorption of tooth roots and absorption of bone, two characteristic processes, involve an irreversible removal both of

*In other words, a liquid or a solid, a dissolved or a suspended particle.

nitrogenous and alkalin earth compounds. Histologists appear to hold that these processes are carried on by osteoclasts; but it is not yet clear whether they only are involved. Somewhat different from these phenomena are the changes in dentin and enamel. In tooth caries the dentin is frequently decalcified, apart from cells, in the denser enamel region, and often following decalcification of the enamel. In all these cases we do not know what alterations of structure have preceded the lesions recorded, nor the effect upon the cells which give rise to the structure.

We have referred to decalcification as a physico-chemical process, not necessarily associated with cell phenomena, whence it would follow the same laws as the solution of similar chemical substances. The enamel of teeth is free from the cells which secreted it and is irreversibly decalcified. As different as the case might appear to be from decalcification of bone, there are, fundamentally, similarities and where the same laws would apply. Principally, both solids are in contact with a liquid phase of a colloidal nature, and comprising various salts in solution. The enamel is always wetted by saliva. Reactions occurring in this medium, like reactions in the gelatinous mass secreted by the bone cell, would affect the solid-liquid relationship. Hence we incline to the suggestion that alterations of the solubility product, the surface energy at phase boundaries, and the constituent in which the calcium and magnesium are soluble, would affect the stability of the solid phase. In the first case, for example, if the product of the concentration of the ions in, say the liquid (ions which can enter into combination with ions in an adjoining solid) is less than the ion product in a solid, formed by their union, the solid will be dissolved. Tricalcium phosphate passes into solution when in contact with acids —nitrous, sulphuric, lactic, carbonic— giving soluble monocalcium phosphate and a calcium compound—nitrite, sulphate, lactate and bicarbonate, e. g.

$$\left.\begin{array}{l} \text{Solid} \qquad\qquad \text{Dissolved} \\ Ca_3(PO_4)_2 \rightleftarrows Ca_3(PO_4)_2 \rightleftarrows 2Ca^{++} + (Ca(PO_4)_2) = = \\ \qquad\qquad 4CH_3CHOH.COOH \rightleftarrows 4CH_3CHOH.COO^- + 4H^+ \end{array}\right\} \rightleftarrows CaH_4(PO_4)_2$$

The general statement in true solutions is that an insoluble salt of a given acid will interact and dissolve when treated with a solution containing another acid if certain conditions prevail, e. g. if the latter acid is much more highly ionized than the former, or the acting acid is more active than the acid formed, or the salt is of an acid which is not present, or if the union of the former anion to the cation in the solid state is less secure than in the case of the cation of the acting acid.

Altho somewhat apart from calcification, another problem is of interest here. The formation of salivary calculi seems not wholly to be explained on the basis of precipitation of calcium salts from true solutions. For one thing, mucinous plaques, salivary and serumal calculi are yet undefined and much confusion exists about them. Assuming—as analyses suggest—that salivary calculi and "tartar" are similar, an alteration of the salt concentration and acid-base balance would facilitate a precipitation of calcium salts upon the enamel. The presence of the calcium layer in contact with a solution laden with calcium salts would hasten this and tend to explain the precipitation at the tooth-saliva boundary rather than the gum-saliva boundary. The relation of mucin films to salivary calculi appears to be a false one, the two being distinct. The former is probably a precipitation of mucin from saliva thru an acid-base alteration or a bacterial development as the work of Gies (24) and Rettger (25) indicates; whereas the latter are, according to

Roberg (26) and others, calcareous concretions with organic matter of variable proportion.

In discussing the chemistry of pathological calcification, Wells (27) considers that the calcium salts may come from the blood, precipitated from protein suspensions of carbonates and phosphates or as calcium-ion-protein compounds, and susceptible to CO_2 influences; that calcification may accompany hyalin degeneration and necrosis; or may follow feeble circulation and low oxidation. In such cases the deposition of calcium salts depends upon one or more of the following conditions:

(1) Increased alkalinity or decreased CO_2.

(2) Utilization of the protein of the calcium borne fluids by starved tissues, lessening the calcium suspension power.

(3) Formation within degenerated area of a substance or substances with affinity for calcium.

(4) Production of a physical condition favoring the local absorption of salts, the least soluble salts accumulating in excess.

Wells points out that the opposite of the first is more true in normal ossification. The second also probably cannot apply to normal ossification. The third explanation could be considered if the presence of phosphoric acid can be admitted (as has been assumed, arising from decomposed nucleoproteins and lecithin) along with fatty acids and some proteins like deuteroalbumose (present in autolyzing areas). But the calcification, whether normal or pathological, borders on proportional alterations of a similar nature and it seems as tho one explanation should care for both. The processes of ossification and pathological calcification Wells viewed as essentially the same, and suggests, as explanatory of both, the alterations of CO_2 content in solutions, as suggested by Hofmeister.

VIII. *Conclusion.*

We have thus far considered the growth and destruction of calcareous tissues, as they may be attributed to certain fundamental physico-chemical processes. The relation of the changes in the calcareous tissues to the acid-base balance, salt content and phase boundary conditions appear to be important and the changes in the tissues may be explained by a careful study of the quantitative alterations of these factors. The changes in the oral flora appear to be dependent upon some of the same fundamental processes also. In just what relation the changes in the denser tooth tissues in the mouth stand to the oral bacteria or to other oral conditions independent of them it will be of value to investigate. The quantitative estimation of the alterations induced by the bacteria is but an aspect of the real problem. We must sooner or later know the structural and functional alterations of the calcareous tissues incident to age, disease and environment. In part only has this been suggested. The teeth, for example, appear to change with age and independent of bacteria in the mouth. Just what the degree of the change or changes is we can only guess at present. These alterations cannot be overlooked, in the control of affections of the denser (calcareous) tooth tissues at least, since they affect the course of changes induced by foreign agents like bacteria. Some will of course say that, with the teeth, bacteria are always present and hence this variable factor must always be considered. But this is only tenable while we are unaware of the relationship between the bacteria themselves and the fundamental factors to which we have referred. Then, too,

the processes in the mouth appear in certain aspects to be similar to some occurring elsewhere, e. g. rickets, caries of bone, where it is inconsistent, with our present ideas of health, to believe bacteria have any influence. The bacteria in the mouth can still be viewed as symbionts, parasitism resulting only from changes in their environment, perchance thru accidental alteration of the bacterial content, but more likely because of alteration attributable to body functional changes which, when made apparent, will likely be found to be within control. The development of a sound basis upon which changes in calcareous tissues can only result will tend to aid in clearing up the matter. Our lack now is the knowledge of the basic factors, criteria to be followed in estimating their role, and ready means of detecting the intensity and order of the changes.

Where we have, in what has gone before, suggested the importance of certain physico-chemical processes underlying the growth, repair, stability and destruction of calcareous tissues, processes which have appeared as significant fundamentally in most all living phenomena, we shall in the next paper examine two of these processes as they are related to the changes in the calcareous tissues of the mouth associated with bacterial metabolism. Experimental work has been undertaken with a view to investigating the changes in hydrogen ion concentration effected by some characteristic oral bacteria and the result of these changes and the proteolytic activities of the same organisms upon teeth and similar structures.

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VOL. 6 OCTOBER, 1919 No. 10

Editorial Department.

SHORT AND BIBLIOGRAPHED PAPERS THE BEST PAPERS.

When you write a paper, make it short and to the point. The editor has recently given careful consideration to the large number of scientific articles which are every year submitted for use in The Journal. We have been tremendously impressed with the fact that, with certain exceptions, the short papers are the best papers. Writers who have something to say seem to be able to condense their thoughts. The paper is given strength and lent interest by this condensation.

The dentist of today is a busy man. He has no time to devote to

long articles. The author who presents his case in a paper of from 2,000 to 2,500 words is certain to attract a much wider audience than a man who uses five to seven thousand words.

Every paper read before a dental society or presented to The Journal for publication should contain a complete bibliography. The time will come when The Journal of the National Dental Association will not accept for publication any paper that does not have a complete bibliography so that any one interested in the subject may have all of the references used by the author in the preparation of his paper. In too many instances, authors of papers on dental subjects have not been careful enough in presenting references to substantiate their statements, or given due credit for work done by other scientific investigators. A writer should avoid repeating material that is common knowledge, for no editor desires to publish trite papers. Every paper read before the National Dental Association meeting in New Orleans should be short and contain a complete bibliography.

TUBERCULOSIS IS CURABLE AND PREVENTABLE AND YET 150,000 DEATHS LAST YEAR. WHY?

The greatest plague with which the human race is afflicted is tuberculosis. According to figures of the National Tuberculosis Association, it claims yearly more than 150,000 lives and there are over a million sufferers from this disease in the United States today.

Furthermore, reports of public experts thruout the country show that between 75 per cent and 90 per cent of the population in any civilized community is infected before the age of 16.

This alarming situation has awakened the public health authorities to an effort to combat this menace. The National Tuberculosis Association and its 1,000 affiliated state organizations have joined a nation-wide crusade.

Funds for carrying on this work are derived chiefly from the sale of Red Cross Christmas seals, enabling every man, woman and child to take part in this "war after the war."

The bright little sticker is literally a messenger of good cheer, a symbol of another chance to those afflicted by the disease.

The colorful tab is a reminder; the deadliest disease of the present age has many hopeful aspects.

A hundred years ago one out of every ten pedestrians was pock-marked. Today, a person with a pitted face is almost a curiosity.

Smallpox yielded to vaccination. Yellow fever practically disappeared when measures were taken to eliminate the mosquito, its carrier.

And there is a cure for tuberculosis. It lies not in medicine, or drugs, but chiefly in the sunlight, fresh air, rest, nourishing food under medical supervision and freedom from worry.

These factors in health restoration are best obtained in a sanitarium. The number of sanitaria in the United States is by no means adequate for the accommodation of those who need these institutions, and need them urgently.

In order to provide these facilities and carry on the work, the National Tuberculosis Association is seeking to raise $6,500,000, chiefly thru the sale of Red Cross Christmas seals.

They are the best health insurance a community can buy.

Every dentist should enthusiastically cooperate in the work of this organization—an association that is helping to relieve humanity from its greatest plague.

FACTS ABOUT TUBERCULOSIS COMPILED BY EXPERTS.

These facts have been gathered together by experts and should receive the careful consideration of every citizen of this great republic.

"Tuberculosis kills producers—chiefly men and women between the ages of 16 and 45.

It causes 150,000 deaths in the United States every year.

It cost the United States in economic waste alone about $500,000,000 annually.

More than 1,000,000 persons in this country are suffering from active tuberculosis right now.

It menaces every community, every home and every individual.

And yet tuberculosis is preventable.

It is spread largely by ignorance, carelessness and neglect."

The National Tuberculosis Association and its 1000 affiliated state and local organizations wage a continuous winning war on tuberculosis.

The work of these organizations is financed chiefly by the sale of Red Cross Christmas Seals.

We should help drive the menace of tuberculosis from our community, state and nation by buying and using Red Cross Christmas seals!

Official Program
—New Orleans

PROGRAM

TWENTY-THIRD ANNUAL SESSION OF THE NATIONAL DENTAL ASSOCIATION.

TO BE HELD IN

NEW ORLEANS, LA., OCTOBER 20, 21, 22, 23, 24, 1919.

MONDAY, OCTOBER 20.

Registration.....8:30 A. M.
(Grunewald Hotel, Mezzanine Floor.)

Board of Trustees.....9:30 A. M.
(Parlor E, Mezzanine Floor, Grunewald Hotel. All subsequent meetings held at same place.)

First Session—House of Delegates.....10:30 A. M.
(Gold Room, Mezzanine Floor, Grunewald Hotel.)
(All subsequent meetings held at same place.)

MONDAY AFTERNOON.

Second Session—House of Delegates.....2:00 P. M.
(Gold Room, Grunewald Hotel.)

TUESDAY MORNING, OCTOBER 21.

FIRST GENERAL SESSION.

10:00 A. M.

(Convention Hall, Twelfth Floor, Grunewald Hotel.)

Invocation.
By the Most Rev. Archbishop Shaw.....New Orleans, La.

Address of Welcome.
By Gov. R. G. Pleasant, on behalf of State.....Baton Rouge, La.
Mayor Martin Behrman, on behalf of City.....New Orleans, La.
B. Cassanas, President Association of Commerce.....New Orleans, La.

Response to Address of Welcome.
By John P. Buckley.....Los Angeles, Calif.

President's Address.
By C. Victor Vignes.....New Orleans, La.

Report of the American Academy of Periodontology on "Methods of Cleaning the Teeth and Case Management." Read by its President, Jules J. Sarrazin.....New Orleans, La.

TUESDAY AFTERNOON.

2:00 P. M.

Prosthetic Dentistry and Crown and Bridge-work.

(Convention Hall, Twelfth Floor, Grunewald Hotel.)

OFFICERS OF SECTION.

William A. Giffin, Chairman.....Detroit, Mich.
609-610 Washington Arcade.

Julius F. Hovestadt, Vice-Chairman..Boston, Mass.
200 Marlboro.

K. G. Knoche, Secretary.....Chicago, Ill.
25 E. Washington St.

PROSTHETIC DIVISION.

"A Study of the Temporo-Mandibular Joint with Special Reference to Lateral Movements of the Jaw in Relation to the Occlusion and Articulation of the Teeth."
By J. Leon Williams, New York City.

"Scientific Interpretation of Muscular Control of Mandibular Movements."
By Geo. H. Wilson.....Cleveland, O.

"Surgical Interference in Preparation of Malformed Mouths for Construction of Artificial Dentures."
By James P. Ruyl.....New York City.

"Correction of Mal-occlusion in Artificial Dentures."
By M. M. House.....Indianapolis, Ind.

"Selection of Artificial Teeth for Prosthetic Restorations."
By P. C. Lowery.....Detroit, Mich.

TUESDAY AFTERNOON.

2:00 P. M.

Oral Surgery, Exodontia and Anesthesia.

(Auditorium, New Elks Home.)

OFFICERS OF SECTION.

Arthur E. Smith, Chairman.....Chicago, Ill.
210 South Lincoln St.
Chalmers J. Lyons, Vice-Chairman, Ann Arbor, Mich.
John W. Seybold.....Denver, Colo.
304 Mack Bldg.

Symposium: "Apicoectomy."

"Its Indications and Contraindications and Root-Canal Technic."
(Illustrated with stereopticon slides.)
By Thomas B. Hartzell.....
.....Minneapolis, Minn.

"Surgical Technic of Apicoectomy."
(Illustrated with stereopticon slides.)
By Chalmers J. Lyons.....
.....Ann Arbor, Mich.

Discussed by
Thomas P. Hinman.....Atlanta, Ga.
William L. Shearer.....Omaha, Nebr.
Carl D. Lucas.....Indianapolis, Ind.
Clarence J. Grieves.....Baltimore, Md.
H. A. Maves.....Minneapolis, Minn.

"Nitrous Oxid-Oxygen Anesthesia in Oral Surgery and Dentistry."
By J. A. Heidbrink.....
.....Minneapolis, Minn.

Discussed by
Wm. H. Deford.....Des Moines, Iowa.
John W. Seybold.....Denver, Colo.
Boyd S. Gardner.....Rochester, Minn.
C. F. B. Stowell.....Chicago, Ill.

"Tic doloureaux—Etiology—Diagnosis—Treatment—Palliative—Blocking and Surgical."
By Rudolph Matas (M. D.).....
.....New Orleans, La.

Discussed by
Herbert A. Potts.....Chicago, Ill.

TUESDAY AFTERNOON.

2:00 P. M.

Orthodontia and Periodontia.

(Auditorium, Parish Medical Building, Adjoining Elks Home.)

OFFICERS OF SECTION.

J. Herbert Hood, Chairman.....Cleveland, Ohio.
1101 Guardian Bldg.
Harry E. Kelsey, Vice-Chairman....Baltimore, Md.
833 Park Ave.
J. Oppie McCall, Secretary.....Buffalo, N. Y.
437 Franklin.

"The Road of Vision in Orthodontia."
By J. A. Cameron Hoggan.....
.....Richmond, Va.

"Necessity for Oral Prophylaxis and Radiology in the Practice of Orthodontia."
By F. M. Casto.....Cleveland, Ohio.

"Observations upon the More Recent Developments in Periodontology."
By Arthur H. Merritt.....
.....New York, N. Y.

"Why the Field of Prophylaxis is Marked with a Lack of Enthusiasm."
By Dorothea A. Howes.....
.....Washington, D. C.

TUESDAY EVENING.

SECOND GENERAL SESSION.

8:15 P. M.

(Auditorium, New Elks Home.)

"War Oral Surgery."
By Major H. D. Gillies, Medical Corps, British Army, Queen's Hospital, Sidcup, England.

WEDNESDAY MORNING.

9:00 A. M.

Operative Dentistry, Materia Medica and Therapeutics.

(Convention Hall, Twelfth Floor, Grunewald Hotel.)

OFFICERS OF SECTION.

J. F. Biddle, Chairman.....Pittsburgh, Pa.
517 Arch St.
H. Herbert Johnson, Vice-Chairman....Macon, Ga.
Commercial Bank Bldg.
Harold S. Smith, Secretary.....Chicago, Ill.
1010 Belmont Ave.

"The Prevention of Chronic Mouth Infection."
(Illustrated with stereopticon slides.)
By Arthur D. Black.....Chicago, Ill.

Abst.—This paper will consider briefly the pathological changes which occur in cases of chronic alveolar abscess and chronic

pericementitis, and will then discuss the causes and take up in detail the methods to be employed in operative dentistry for their prevention. Extensive studies of radiographs of root fillings will be reported, and means of simplifying pulp treatment and root-canal technic will be presented. Particular stress will be laid upon improvements in operative procedures to prevent peridental infection.

Discussed by
H. E. Friesell.....Pittsburgh, Pa.
A. H. Hipple.....Omaha, Neb.

"X-ray in Dental Practice."
By C. Edmund Kells.....
.....New Orleans, La.

Discussed by
H. B. Tileston.....Louisville, Ky.
Howard R. Raper, Albuquerque, N. M.

WEDNESDAY MORNING.

9:00 A. M.

Organization, Mouth Hygiene and Public Service.

(Gold Room, Mezzanine Floor, Grunewald Hotel.)

OFFICERS OF SECTION.

C. M. Kennedy, Chairman.....Des Moines, Ia.
605 Citizens Bank Bldg.
Charles H. Oakman, Vice-Chairman..Detroit, Mich.
1241-1247 David Whitney Bldg.
Burton Lee Thorpe, Secretary.....St. Louis, Mo.
415 Metropolitan Bldg.

SPECIAL ANNOUNCEMENT.

The talent for this section has been especially selected to present the proper subjects in a manner that should terminate in an organization that will meet the demand of the people as well as the profession for education in preventive dentistry.

Preventive Dentistry is all important and covers a vast field touching upon every phase of our profession and extending into the deep realms of general health. No one can practice true dentistry in any one of its branches without knowledge of the fundamentals of Mouth Hygiene and real results are not to be obtained without organization.

On Wednesday morning we would urge that all State and District Society officers and College and University instructors be present for a special program has been arranged for them.

On Thursday morning, with the same promptness, those interested in doing the greatest good for the largest number should be there with eager attention. Will it be Public Service?—Chairman.

Report of the Minnesota Division.

(a) "The Value of Blood and Urine Examinations in Dental Practice."

(b) "The Relative Frequency of Bacterial Invasion of the Vital Pulp; Its Explanations and Source."

By Arthur T. Henrici and Thomas B. Hartzell.....
.....Minneapolis, Minn.

"Possibilities and Importance of Educating the Dentist thru Organization."

By E. R. Swank.....Des Moines, Iowa.

Discussed by
C. R. Lawrence.....Enid, Okla.
Homer Brown.....Columbus, Ohio.
G. Walter Dittmar.....Chicago, Ill.
Charles F. Ash.....New York City.

"Government Recognition of Mouth Hygiene."

By Major H. B. Butler, D. C., U. S. A., Walter Reed Hospital, Washington, D. C.

"Come Clean." (Three-Reel Film Made at the Army Medical Museum, by Direction of Surgeon General's Office).

By Major Leonard G. Mitchell, D. C., U. S. Army, St. Elizabeth Hospital, Washington, D. C.

WEDNESDAY MORNING.

9:00 A. M.

Histology, Physiology, Pathology, Bacteriology and Chemistry—Research.

(Auditorium, Parish Medical Building, Adjoining Elks Home.)

OFFICERS OF SECTION.

Weston A. Price, Chairman.....Cleveland, Ohio.
8803 Euclid Ave.
Frank O. Hetrick, Vice-Chairman..Ottawa, Kansas.
324 Main St.
Harris R. C. Wilson, Secretary....Cleveland, Ohio.
701 Schofield Bldg.

"How Mouth Infection Affects the Kidneys."

By Thomas B. Hartzell.....
.....Minneapolis, Minn.

"Nutrition in Relation to Dental Diseases."

By Percy R. Howe.....Boston, Mass.

"Focal Infections and Tissue Specificities."

By Guthrie McConnell, M. D. (Superintendent of Laboratories of the Research Institute of the National Dental Association) .....Cleveland, O.

WEDNESDAY MORNING.

9:00 A. M.

(Charity Hospital.)

Oral Surgery Clinics.

Truman W. Brophy.....Chicago, Ill.
"Cleft Palate."
(Operating Room, Miles Amphitheatre.)

Homer Dupuy.....New Orleans, La.
"Maxillary Sinus."
(Operating Room Miles, Delgado Bldg.)

Leroy N. S. Miner.....Boston, Mass.
"Surgical Clinic."
(Operating Room E. Lewis, Delgado Bldg.)

William L. Shearer.....Omaha, Neb.
"External Alveolectomy or Cleft Palate."
(Operating Room Matas, Delgado Bldg.)

WEDNESDAY AFTERNOON.

2:00 P. M.

Prosthetic Dentistry, and Crown and Bridge-work.

(Convention Hall, Twelfth Floor, Grunewald Hotel.)

CROWN AND BRIDGE DIVISION.

"Porcelain Jacket Crown Technic."
By A. L. Legro.....Detroit, Mich.

"Cast Clasp Technic in Removable Bridge-work."
By Norman B. Nesbett, Boston, Mass.

"The Gold Shoulder Crown Technic."
By Wm. H. Elliott.....Detroit, Mich.

"Definite Technical Procedure Which Will Minimize Debasement of Precious Metals and Their Alloys When Used In the Construction of Cast Clasps, Lingual Bars, Dowels and Other Appliances Used as Attachments for Prosthetic Restorations."
By L. J. Weinstein....New York City.

"The Range of Occlusion In Construction of Bridge-work."
By Geo. S. Monson.....St. Paul, Minn.

"Fixed Bridge Attachments for Vital Teeth."
By E. F. Tinker....Minneapolis, Minn.

WEDNESDAY AFTERNOON.

2:00 P. M.

Oral Surgery, Exodontia and Anesthesia.

(Auditorium, New Elks Home.)

"Impacted Lower Third Molar."
(Illustrated.)
By George B. Winter—St. Louis, Mo.
Discussed by
J. P. Henahan.....Cleveland, O.
Harry W. Allen.....Kansas City Mo.
O. T. Dean.....Seattle, Wash.
Roy S. Hopkinson....Milwaukee, Wis.
Leroy S. Miner.....Boston, Mass.

Symposium: "Block Anesthesia."

"Preparation of Solution."
By E. A. Litchfield....Humboldt, Nebr.

"Pharmacology, Action and Toxicity of Various Local Anesthetics."
By Samuel L. Silverman.....Atlanta, Ga.

"Indications and Contraindications."
By Fred F. Molt.....Chicago, Ill.

"Suggestive Therapy and Treatment of Abnormal Conditions During and Following Injections."
By P. G. Puterbaugh.....Chicago, Ill.

"Diseases of the Antrum."
(Illustrated with stereopticon slides.)
By Charles H. Oakman, Detroit Mich.
Discussed by
R. Boyd Bogle.....Nashville, Tenn.
Truman W. Brophy.....Chicago, Ill.

WEDNESDAY AFTERNOON.

2:00 P. M.

Orthodontia and Periodontia.

(Parish Medical Building.)

"Differential Diagnosis of Periodontoclasia."
By John Oppie McCall..Buffalo, N. Y.

"Congenial Nonocclusion."
By Paul R. Stillman..New York, N. Y.

"An Analysis of Case Characteristics with Reference to the Selection of the Most Efficient Form of Appliance for Treatment."
By A. H. Ketcham.....Denver, Colo.

"The Problem of Retention."
By C. A. Hawley....Washington, D. C.

WEDNESDAY AFTERNOON.

4:15 P. M.

Third Session—House of Delegates.

(Gold Room, Grunewald Hotel.)

WEDNESDAY EVENING.

THIRD GENERAL SESSION.

8:00 P. M.

(Auditorium, New Elks Home.)

"Studies on the Problem of Infection."
By Winford P. Larson.....Minneapolis, Minn.

"The Phenomena of Inflammation—A Practical Interpretation."
By Guthrie McConnell, M. D. (Superintendent of Laboratories of the Research Institute of the National Dental Association).....Cleveland, Ohio

THURSDAY MORNING.

9:00 A. M.

Operative Dentistry, Materia Medica and Therapeutics.

(Convention Hall, Twelfth Floor, Grunewald Hotel.)

"Some Recommendations for the Sterilization and Filling of Infected Roots."
By Weston A. Price.....Cleveland, O.
Discussed by
Clarence J. Grieves.....Baltimore, Md.
Percy R. Howe.....Boston, Mass.

"The Gold Inlay."
By R. H. Volland.....Iowa City, Iowa.
Discussed by
Wallace Wood.....New Orleans, La.
W. L. Fickes.....Pittsburgh, Pa.

THURSDAY MORNING.

9:00 A. M.

Organization, Mouth Hygiene and Public Service.

(Gold Room, Mezzanine Floor, Grunewald Hotel.)

"Dental Service for the Other Eighty Per Cent."
By Guy Millberry, San Francisco, Cal.
Discussed by
Albert H. Stevenson, New York City.
E. L. Pettibone.....Cleveland, O.
Wm. R. Wright.....Jackson, Miss.
H. E. Friesell.....Pittsburgh, Pa.
G. M. Cooper, M. D.....Raleigh, N. C. (Director Bureau of Medical Inspection of Schools, North Carolina State Board of Health.)
Frank L. Platt.....San Francisco, Cal.
John D. Millikin..San Francisco, Cal.

"Oediadontia."
By Philip R. Thomas.....Minneapolis, Minn.
Discussed by
Thomas McCrum....Kansas City, Mo.
Haidee Weeks Guthrie.....New Orleans, La.
Evangeline Jordan..Los Angeles, Cal.
Maude Tanner.....Portland, Ore.
Grace Rogers Spalding.....Detroit, Mich.
Gillette Hayden.....Columbus, O.

"Solving the Mouth Hygiene Problem."
By Otto U. King.....Chicago, Ill.
Discussed by
C. C. Sparrow.....Minneapolis, Minn.
H. J. Burkhart.....Rochester, N. Y.
Charles H. Oakman.....Detroit, Mich.
J. P. Luthringer.....Peoria, Ill.

THURSDAY MORNING.

9:00 A. M.

Histology, Physiology, Pathology, Bacteriology and Chemistry-Research.

(Auditorium, Parish Medical Building, Adjoining Elks Home.)

"The Dento-Cemental Junction."
By Harold K. Box....Toronto, Canada

"Physiology and Pathology of Interest to Dentists."
By J. J. Sarrazin....New Orleans, La.

"A Note on Staining and Mounting Sections of the Dental Tissues."
By Arthur Hopewell-Smith.....Philadelphia, Pa.

"(a) Variations in Susceptibility to the (so-called) Rheumatic Group Lesions and to the Influence of Oral Focal Infections.
(b) The Relation of Oral Sepsis to the Development of Complications With and Following Influenza."
By Weston A. Price, Cleveland, Ohio

THURSDAY MORNING.

9:00 A. M.

(Charity Hospital.)

Oral Surgery Clinics.

Frederick B. Moorehead.....Chicago, Ill.
"Harelip."
(Operating Room, Miles Amphitheatre.)

Carl D. Lucas.....Indianapolis, Ind.
"Surgical Clinic."
(Operating Room Matas, Delgado Bldg.)

Charles H. Oakman.....Detroit, Mich.
"Maxillary Sinus."
(Operating Room E. Lewis, Delgado Bldg.)

THURSDAY AFTERNOON.

2:00 P. M.

(Auditorium, New Elks Home.)

General Clinic.....2:00 to 5:00 P. M.

(See Clinic Program below.)

THURSDAY AFTERNOON.

4:00 P. M.

Fourth Session—House of Delegates.

(Gold Room, Grunewald Hotel.)

House of Delegates. (This last roll call will be the "Permanent and Official Roll Call" of the 1919 Meeting.)

THURSDAY EVENING.

FOURTH GENERAL SESSION.

8:15 P. M.

(Convention Hall, Grunewald Hotel.)

"The Responsibility of the Dentist Towards the Symptomatology of Diseases of the Mouth, Especially Syphilis."

By Charles V. Herdliska, M. D. A. A. Surgeon, U. S., Public Health Service, Washington, D. C.

(Illustrated by new moving picture reels.)

FRIDAY MORNING.

9:00 A. M.

(Auditorium, New Elks Home.)

General Clinic.....9:00 to 12:00 A. M.

FRIDAY MORNING.

9:00 A. M.

(Charity Hospital.)

Oral Surgery Clinics.

Herman B. Gessner.....New Orleans, La.
"Surgical Clinic."
(Operating Room Matas, Delgado Bldg.)

V. P. Blair.....St. Louis, Mo.
"Surgical Clinic."
(Operating Room, Miles Amphitheatre.)

R. Boyd Bogle.....Nashville, Tenn.
"Maxillary Sinus."
(Operating Room E. Lewis, Delgado Bldg.)

FRIDAY MORNING.

11:00 A. M.

LAST GENERAL SESSION.

(Gold Room, Mezzanine Floor, Grunewald Hotel.)

(Installation of Officers, etc.)

THE GENERAL CLINICS.

TWO HALF DAYS.

Thursday Afternoon, October 23, 2 P. M.
Friday Morning, October 24, 9 A. M.

AUDITORIUM—NEW ELKS HOME.

S. H. McAfee, Chairman,
1225 Maison Blanche Bldg.,
New Orleans, La.

E. B. Ducasse
Wm. J. Healey
H. J. Feltus

Fred Ratzburg
M. B. Varnado

The General Clinics will be held in the auditorium, new Elks Home. They will consist principally of table clinics. Space for as many as can see and hear will be provided for each clinic.

A placard indicating the number of the clinic will be suspended over each table, easily seen from any point in the auditorium. These numbers will correspond to numbers in the printed program which will give titles of clinics, names of clinicians, etc.

Members are requested to study this program beforehand, select the clinics they wish to see, make a note of the numbers, and on entering the auditorium familiarize themselves with the location of these numbers.

Half of the clinics will be given in full at the first session of clinics (Thursday

Afternoon) and half at the second session, (Friday Morning.) For example: If there are ten different clinics on Denture Construction, five of them will be given at the first session and five at the second session. The idea being to give some of every type of clinic at each session. This will make it practicable for the clinicians themselves to see some of the clinics. It will give those attending the opportunity of seeing twice as many clinics.

This year the clinics will all begin at a given signal, run thirty minutes, and finish at a given signal. A few minutes intermission will be allowed for rest, and for the audience to 'progress' individually, at pleasure. At the signal all clinics will begin (from the beginning) and repeat. It is believed that this arrangement will avoid in a measure the confusion of the continually floating audience. The audience will at least know when the clinics are starting and stopping.

The audience is requested to move promptly at the signals, to not interrupt clinicians during the clinics, and to refrain from unnecessary conversation and noise.

Clinicians are requested to report upon arrival at the Clinic Hall to the Clinic Committee, who will have sufficient assistants to afford Clinicians every facility for carrying on their work.

Clinicians are expected, as far as possible, to furnish all necessary instruments and equipment.

The Clinics will commence at 2 P. M. and 9 A. M. sharp. All Clinicians are expected to be at their tables on time.

Tables for the Unit Clinics will be arranged so that the largest possible number will be able to witness the Clinics in the order in which they are arranged.

No one will be allowed to sell any instrument, materials or appliances in the Clinic Hall.

1

James Kendall Burgess....New York City.
"A Direct Method of Bridge-work Based on the Indirect Methods of Attachment Construction."

2

C. M. Ballenger.....Lubbock, Texas.
"A Correct Method of Mounting Models in Articulator in Bridge-work."

3

Wm. John Healey.....New Orleans, La.
"A Form of Fixed Sanitary Bridge upon Vital Teeth."

4

Albert W. Marshall.....San Antonio, Tex.
"Bridge Abutments: Conserving Pulps."

5

M. T. Moran.....Deming, N. M.
"Easy Cleansing Bridge Dummies by an Economical Method."

6

F. H. Skinner.....Chicago, Ill.
"A Pin Inlay Bridge, Eliminating in a Measure, the Probability of One End Loosening or of a Tooth Splitting."

7

Herbert F. Stevens.....Aberdeen, S. D.
"Making Current Literature a Quick Reference Library."

8

Nye W. Goodman.....Los Angeles, Cal.
"Porcelain Jacket Crown Technic."

9

W. A. Coston.....Topeka, Kans.
"Demonstrating Technic of Making Shoulder Crown."

10

Percy R. Howe.....Boston, Mass.
"The Complete Sterilization and Blocking of Diseased Dentin, and of Pulpless Roots by Silver Nitrate Reduction."

11

Arthur B. Crane.....Washington, D. C.
"Culture Methods in Root-canal Work."

12

E. A. Smith.....New York City.
"Practical Methods of Obtaining Cultures from Roots of Devitalized Teeth."

13

C. A. Martin.....Winfield, Kans.
"Little Conveniences."

14

E. C. Glass.....Independence, Kans.
"Crowns, Fillings and Inlays with Tooth Forms."

15

J. T. Kernan.....Wichita, Kans.
"Use and Construction of Partial Cast Crowns."

16

Chas. G. Hartley.....Los Angeles, Cal.
"Porcelain Jacket Crown Technic."

17

Rupert E. Hall.....Chicago, Ill.
Assisted by E. E. Bailey, Denver, Col.
"Artificial Dentures."

18

Dayton Dunbar Campbell.....
.....Kansas City, Mo.
"A Practical Demonstration of the Esthetic Possibilities of Continuous Gum Dentures."

19

Leonidas F. Smith.....Indianapolis, Ind.
"The Only Correct Principles upon which to Construct Full Upper and Lower Dentures, Showing the Simplicity of the Method."

20

George T. Baker.....Boston, Mass.
"Orthodontia."

21

Victor Hugo Jackson.....New York City.
"The Plan and Efficiency of the Jackson System of Orthodontia."

22

Jas. P. Ruyl.....New York City.
"Surgical Treatment of Abnormal Mouths Before Putting in Artificial Dentures."

23

Ralph Fouser.....Salem S. D.
"Preparation of the Solution for Nerve Blocking."

24

"Maxillo Facial Exhibit."
(This exhibit has been prepared at the Walter Reed General Hospital and United States Army General Hospital No. 2, Fort McHenry, Maryland. It will be in charge of Dental Corps men appointed by the Surgeon General's office. This exhibit will consist of photographs, X-rays, models, casts, splints of all sorts, mounted and otherwise, and also reproductions of some of the extensive reconstructive bridge work done at these hospitals.)

25-26-27

THE DES MOINES TOOTH-BRUSH CLINIC. UNIT CLINIC.

C. M. Kennedy.....
W. J. Cameron.....Des Moines, Iowa.
W. J. Charters.....

28

Frank M. Wadsworth..Minneapolis, Minn.
"Partial Denture Articulation and Selection of Harmonious Tooth Forms."

29

Chas. A. Spahn.....Newark, N. J.
"A New Technic for Clasp Construction and its Application to Orthodontia."

30

Thos. M. Terry.....New Orleans, La.
"Splints Used in Gun Shot Wounds of the Face and Jaws."

31

E. A. Litchfield.....Humboldt, Nebr.
"Scientific Preparation of the Vehicle and the Injecting Solutions for Nerve Blocking."

32

E. P. Beadles.....Norfolk, Va.
"Pyorrhea."

33

R. H. Volland, Assisted by E. S. Smith
.....Iowa City, Iowa.
"A Simplified Method of Casting Gold Inlays."

34

Karl W. Knapp.....Des Moines, Iowa.
"Special Inlay Technic."

35-38

THE WISCONSIN GOLD INLAY UNIT.

Four Tables Demonstrating Various Procedures from Cavity Preparation to Casting.

H. G. Morton, Chairman.

Table 1—J. G. Schottler and N. E. Uelman, Milwaukee.

Table 2—W. H. Schaller and H. P. Jahn, Milwaukee.

Table 3—F. W. Heinemann and T. L. Gilbertson, Milwaukee.

Table 4—C. M. Schwendener and H. G. Morton, Milwaukee.

39

F. H. Waters.....Ames, Iowa.
"A Technic in Making Wax-Pattern for Gold Inlays."

40

Elmer S. Best.....Minneapolis, Minn.
"Standardized Oral Examination for the Isolation of Decisive Factors, Determining Conservation or Loss of Non-Vital Teeth."

FRIDAY MORNING.

101

W. F. Barry.....Orange, N. J.
"Mechanically Anchored Abutments in Bone for the Support of Artificial Reconstructions."

102

Howard T. Stewart.....New York City.
"Removable Bridge-work."

103

R. H. Roneberger.....St. Louis, Mo.
"Gold Cast Crowns with Baked Porcelain Veneer."
"Porcelain Cone Roots and Incisal Tips Baked on Steele's Trubyte Facings, Together with Other Novel Porcelain Technic."

104

E. T. Tinker.....Minneapolis, Minn.
"Bridge Abutments for Vital Teeth and Porcelain Tipped Dummies."

105

Geo. M. Hollenback.....Los Angeles, Cal.
"The Technic of Making Bridge Abutments, Using Vital Teeth."

106

Dr. A. W. Ward.....San Francisco, Cal.
"Advanced Prophylaxis."

107

Geo. B. Clement.....Meridian, Miss.
"The Use of the Electric Cautery in the Treatment of Pyorrhea, Using Split Electrodes."

108

Hugh Avary.....San Francisco, Cal.
"The Esthetic Restoration of Tooth Form with Porcelain Jacket Crowns."

109

Wm. H. Elliott.....Detroit, Mich.
"The Gold Shoulder Crown Technic."

110

S. E. Brice.....Lewiston, Mont.
"Demonstrating the Impossibility of Properly Filling Root-canals."

111

Ewing P. Brady.....St. Louis, Mo.
"A Comparison of Root Filling Materials."

112

Abram Hoffman.....Buffalo, N. Y.
"Orthodontia—The Lingual Arch as Suggested by Dr. J. B. Mershon and Modifications."

113

R. P. Thomas.....Louisville, Ky.
"Synthetic Veneers."

114

Chas. A. Tavel.....Memphis, Tenn.
"A Non-irritating Posterior Crown."

115

A. L. LeGro.....Detroit, Mich.
"Porcelain Jacket Crown Technic."

116

W. A. Squires.....Salt Lake City.
"Porcelain Jacket Crowns."

117

Dr. (?) .....Honolulu
"Subject (?)"

118

Ewell Neil.....Nashville, Tenn.
"Esthetics in Plate Prosthesis."

119

John B. LaDue.....Mattoon, Ill.
"Bite Taking for Full Upper and Lower Dentures."

120

F. Ewing Roach and G. W. Dittmar.....Chicago, Ill.
"Clasps and Attachments for Retaining Partial Artificial Removable Dentures, also showing a Technic for Accurate Cast Clasp Construction."

121

C. A. Hawley.....Washington, D. C.
"Removable Retention."

122

Wm. H. and J. R. DeFord.....Des Moines, Iowa.
"The Unimpacted Lower Third Molar."

123

Ned A. Stanley.....New Bedford, Mass.
"Treatment of Pyorrhea by Instrumentation."

124

P. C. Lowery.....Detroit, Mich.
"Esthetic Selection and Arrangement of Artificial Teeth."

125

M. M. House.....Indianapolis, Ind.
"Correction of Mal-occlusion in Artificial Dentures."

126

W. Clyde McClelland.....Kansas City, Mo.
"A Technic for Constructing Continuous Gum Dentures."

127

R. R. Blanchard.....Springfield, Ill.
"Impressions and Casts for Full Dentures."

128

Chas. A. Furrow.....Tulsa, Okla.
"Modern Technic of the Various Forms of the Roach Attachments."

129

C. L. Alexander.....Charlotte, N. C.
"A Demonstration of the Alexander Orthodontia Appliance, Showing Results."

130

Daniel H. McCauley.....Laurel, Montana.
"Ununited and Infected Maxillar and Mandible Fractures due to Gunshot Wounds."

131

B. B. McCollum.....Los Angeles, Cal.
"Inlay Technic."

132

Ira G. Nichols.....Mandan, N. D.
"Nerve Blocking. Demonstrating the Effects of the Hypotonic; Isotonic and Hypertonic Solutions Upon the Blood and Tissue Cells."

133-139

THE WISCONSIN DENTURE UNIT.

Seven tables, Demonstrating Various Procedures in Modern Denture Construction.

Geo. P. Brenner, Chairman.

Table 1—A. A. Jennings and C. J. Jane, Milwaukee.

Table 2—Geo. P. Brenner, C. E. Gage, P. G. Hirtz, Milwaukee.

Table 3—W. F. Faust and J. W. Lewis, Milwaukee.

Table 4—D. E. Ihde and Theo. Kuechle, Milwaukee.

Table 5—E. R. Lamp and V. A. Smith, Milwaukee.

Table 6—A. J. Richter and J. J. Ruhland, Milwaukee.

Table 7—C. W. Hall, P. W. Rood, O. A. Droegkamp, Milwaukee.

140

Arthur E. Smith.....Chicago, Ill.
"Block Anesthesia Technic for Oral Surgery and Dentistry, by the Use of Dissected Wet Anatomical Specimens, Charts, Diagrams and Skulls. New Technic will be Shown for Blocking the Gasserian Ganglion; Second Division of the 5th Nerve; Intra-Osseous Anesthesia, also Deep Nerve Block for Tonsillectomy and Antrum Cases."

SCHEDULE OF TRAINS AND RATES TO NEW ORLEANS.

It is not the policy of the United States Railroad Administration to grant special rates for conventions, and as a consequence we will have no special rates for this meeting. Winter tourist round-trip tickets will be on sale October 1st, with extreme return limit of May 31st, 1920. The tariffs covering winter tourist rates and the territory from which they will apply are not available in time for this publication, it is therefore advisable for our members to consult the Local Ticket Agent or Consolidated Ticket Office as the case may be relative to rates and conditions pertaining to the winter tourist ticket.

If diverse route is desired returning that fact should be made known at the time of purchase and route specified as the rate may be slightly effected.

Seeing the many advantages of bringing our members together at the most available points thus enabling them to travel together the greatest possible distance it has been decided to use the Panama Limited of the Illinois Central, Chicago to New Orleans, on schedule as follows:

Leave	
Chicago (October 18)	12:30 Noon
Kankakee	1:57 P. M.
Champaign	3:28 P. M.
Mattoon	4:23 P. M.
Effingham	4:58 P. M.
Centralia	6:11 P. M.
Carbondale	7:30 P. M.
Cairo	8:33 P. M.
Memphis	1:10 A. M.
Grenada	3:35 A. M.
Canton	5:58 A. M.
Jackson	6:45 A. M.
Hammond	9:45 A. M.
Arrive Sunday, Oct 19th.	
New Orleans	11:15 A. M.

Members from Boston, New York, Philadelphia and intermediate points will find desirable train service on the several lines enabling them to make connection with the above at Chicago. The same is true for members from the extreme Northwestern and Northern California territory thru Denver, St. Paul and Minneapolis. Members from Indianapolis, Louisville and contiguous territory can also avail themselves by connections at various points.

Buy tickets of your local agent and specify the National Dental Association train for your reservations.

Fare From Chicago to New Orleans.

Fare from Chicago to New Orleans, including war tax	$30.35
Fare from Chicago to New Orleans and return, including war tax, (winter tourist rate)	55.11
Lower berth Chicago to New Orleans, including war tax	5.94
Upper berth, Chicago to New Orleans, including war tax	4.75
Drawing room, Chicago to New Orleans, including war tax	21.60
Compartment, Chicago to New Orleans, including war tax	16.74

Trip to Havana—Expenses.

Many inquiries have been received regarding the expense of a trip to Havana, and for the benefit of those interested your Committee has compiled the following data:

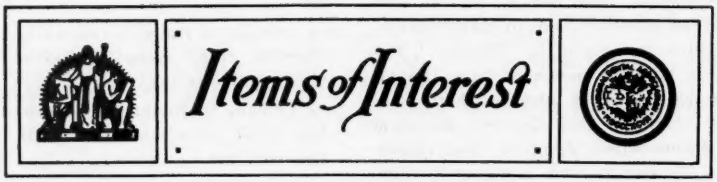
New Orleans to Havana, one-way, including berth, meals and war tax	$41.00
New Orleans to Havana, round-trip (Special rate) including berth, meals and war tax	73.40
New Orleans to Havana, thence to New York, including berth, meals and war tax	84.20
Or returning via Key West—Havana to Key West	16.00
Key West to Chicago, via Jacksonville	53.18

Sailing from New Orleans, via. "The Great White Fleet" of the United Fruit Co., Saturday, October 25th, 48 hours to Havana, Complete round trip one week.

Sailings from Havana to Key West, daily except Thursday and Sunday. Daylight trip, 11 A. M. to 7 P. M.

Also in this connection will advise that passports and deposits covering reservations are necessary. In addition passengers will be required to carry with them certificates showing full payment of 1917 and 1918 income taxes or exemption therefrom. These may be obtained from the local Collector of Internal Revnue. For further information address F. S Bishop, C. P. A., 112 West Adams St., Chicago, Ill.

D. C. BACON, Chairman,
Transportation Committee N. D. A.,
31 N. State St., Chicago, Ill.



NAVAL OFFICER OF DENTAL CORPS, RETIRED, HELD IN HIGH ESTEEM.

Lieut.-Com. Richard Grady, Dental Corps, U. S. N., (retired), for twenty years in charge of the Dental Department at the Naval Academy and founder of the Baltimore Polytechnic Institute, now has his residence in the Homewood Apartments, Baltimore.

Dr. Grady has a country-wide reputation for the work he has done in his profession. He is a graduate both of the Baltimore College of Dental Surgery and of the University of Maryland, School of Medicine.

A fitting reward for his long services was given him when he was retired this year with permanent rank of lieutenant-commander, he being the only dental surgeon to retire with that rank.

The esteem in which Dr. Grady was held by the Midshipmen at the Naval Academy is shown by the farewell given him in the "Log," the weekly paper published by the midshipmen:

"Lieut. Com. Richard Grady, serior dental officer of the Navy, has just been retired after a long, masterful and useful career in the service. He has been continuously in charge of the dental department at the Naval Academy since 1899, and has put in more overtime labor and gratuitous service than the vast majority of medical corps officers. He has taken an important part in the organization of the leading dental schools and clinics of the country, and his system for record and plan for the care of school children's teeth have nation-wide usage today.

"His activities have not been confined to medicine, for he has found time to stamp his executive ability upon many movements in industrial educations and philanthropic economics. The Association of Dental Surgeons, the Baltimore Polytechnic Institute, the Industrial Educational—all have been forwarded by his work for them, and his public lectures and addresses have been potent factors in bringing the importance of oral hygiene before the people.

"Doctor Grady even found time in his busy career to contribute to the Naval Academy Bulletin, the early forerunner of The Log.

"The highest naval authorities and Congress have given unstinted praise to his meritorious career in the service, and the regiment joins in expressing the desire that his retirement will not lessen his interest nor his activities towards making the world a better place to live in."

Altho Dr. Grady is retired from active service, he has lost none of his interest in the Navy. He made a trip to Virginia to see the Pacific fleet as it steamed away. On Tuesday he called on Commander P. V. H. Weems, at the Navy Recruiting Headquarters, 125 E. Baltimore St., Baltimore, Md., and offered his services in the recruiting drive.—*Annapolis Capital.*

DENTISTS' SOCIETY TO BE REORGANIZED FOR OFFICERS HERE.

Because of the rapid movement of troops from the American Forces in Germany and the gradual breaking up of many units, the meetings of the Third Army Dental Society have been discontinued. Plans are already under way, however, for a reorganization of the society by the dental surgeons who will remain with the permanent Rhine forces and a renewal of the semi-monthly meetings.

The society was first organized for the purpose of bringing dental surgeons in the Army of Occupation closer together and at the same time offering them an opportunity for an exchange of views and a discussion of subjects which would benefit their work and make their service to the men in the army more valuable.

The Third Army Dental Society was organized at a get-together dinner at the Officers' Club on May 30 and Colonel Boak was elected Honorary President; Colonel Taylor, President; Captain T. M. Wheat, Vice President; Captain B. M. Spes, Secretary and Major J. B. Harrington Historian. Close to 30 officers attended the informal dinner and became charter members of the organization. At this time it was decided to hold meetings every two weeks.

The second meeting of the organization was held on June 6 in the offices of the Attending Dental Surgeon. More than 50 dentists of the army were present and a picture of the organization was taken. A clinic was held by Captain C. W. Scogin on Exodontia and the successful use of conductive anesthesia in dentistry demonstrated. Captain B. M. Epes also conducted a clinic on Vincents Angina, commonly known as trench mouth, by the aid of patients and slides and demonstrated the treatment of the infection.

Captain Austin of Evacuation Hospital 16 read an interesting and instructive paper on the correlation of diseases of the nose and throat of oral mucosa.

Colonel Boak gave a lengthy discussion and demonstration of the Howe Treatment at the third meeting on June 21. Col. Boak emphasized his talk with the use of charts and clearly demonstrated the uses and benefits of this treatment.

Colonel Ferrenbaugh of the Chief Surgeon's office also gave an interesting talk on Ludwig's Anginus. Close to 50 members of the society attended the dinner, a general good time following the talks.

The last meeting of the society was held on July 5 and opened with a dinner. Dr. Corwin of Denver, Colorado, was a guest of the society and delivered an interesting talk on the methods used in companies in which he is interested by dental surgeons in caring for the teeth of their employees.

Before the next meeting was held a large number of the troops in the Rhineland started on the move toward the States and the meetings were postponed until the permanent forces had been selected. Plans are already under way to have the meetings revived. This is regarded as one of the best means of keeping in touch with local problems and the discussion of new methods and discoveries in dentistry.—*The Amaroc News, American Army of Occupation.*

ROOSEVELT MEMORIAL ASSOCIATION.

August 20, 1919.

Editor National Dental Association House Organ, Chicago, Ill.

Dear Sir: The Roosevelt Memorial Association has been organized by a number of friends of the late Colonel Roosevelt and subscriptions to a fund of five million dollars will be taken during the week of October 20th-27th of this year.

The object of the fund is:

To provide memorials in accordance with the plans of the National Commit-

tee, which will include the erection of a suitable and adequate monumental memorial in Washington; acquisition, development and maintainance of a park in the town of Oyster Bay which may ultimately, perhaps, include Sagamore Hill, to be preserved like Mount Vernon and Mr. Lincoln's home at Springfield.

That you may be advised of the objects of the Association, we are enclosing an appeal that is being printed by magazines thruout the country, and a booklet.

We have received a great deal of encouragement from the editors of the different magazines, and we are hopeful that you will see your way either to print an article or editorial for your magazine, or reproduce the appeal sometime between now and the month of October. The article or editorial will be written at the headquarters of this association if you do not care to prepare it yourself.

We will consider it a great favor if you will advise us promptly if we can count upon you in this very worthy matter.

Yours very truly,

WM. BOYCE THOMPSON,
President.

ROOSEVELT MEMORIAL ASSOCIATION.

The Roosevelt Memorial Association has been formed to provide memorials in accordance with the plans of the National Committee, which will include the erection of a suitable and adequate monumental memorial in Washington; and acquiring, development and maintenance of a park in the town of Oyster Bay which may ultimately, perhaps, include Sagamore Hill, to be preserved like Mount Vernon and Mr. Lincoln's home at Springfield.

In order to carry this program to success, the Association will need a minimum of $5,000,000, and so that participation in the creation of this memorial fund may be general, it asks for subscriptions thereto from millions of individuals.

Colonel Roosevelt ,was the greatest American of his generation. He blazed the trail which this nation must travel. Unselfish and sincere in purpose, unswerving in seeking the right and following it, definite and direct in action, with his theory of personal responsibility for wrong-doing and his creed of "the square deal" for all, he gave a lifetime of devoted public service which must stand as an inspiration to the youth of this land for all time. Ardently American, believing profoundly that only thru fullest acceptance of America's privileges and responsibilities could the people of this country realize their highest well-being and fulfill their obligations to themselves and to humanity, he set up ideals which it is not only a duty but a privilege to follow.

A memorial to this man will not so much honor him as honor America and the citizens who raise it to him. A contribution to the Roosevelt Memorial will be, in the highest sense, a pledge of devotion to ideal citizenship. Checks may be sent to Albert H. Wiggin, Treasurer, Roosevelt Memorial Association, 1 Madison Avenue, New York City.

WILLIAM BOYCE THOMPSON,
President, Roosevelt Memorial Association,
1 Madison Avenue, New York City.

PEDDLERS IN UNIFORM.

Complaints continue to be heard of the appearance on the streets of the large cities, of men in the uniform of the service engaged in the sale of periodicals and articles of merchandise. This is nothing less than an appeal to charity, and in a form that is highly objectionable to those who have worn the uniform in war. They are not likely to endorse any such misuse of the visible badge of honorable service, and may be expected to be the first to protest against its prevalent occurrence. The military and naval authorities have acted wisely in issuing warnings against this occupation

in which men in uniform engage. The public should need only to be cautioned from responsible sources to obtain and apply the most effective means of abating the nuisance. There is, of course, no reason why men who have served in the Army, Navy and Marine Corps are forced to the extremity of peddling in the garb that reveals their former connection with the service; there is sufficient work of a less humiliating character in all localities for the able-bodied youth of the country, while those who have been disable in service are being provided with the means of earning a livelihood without resort to curbstone trafficking that is not far removed from mendicancy. It is only natural that, at least for a time, the people should feel friendly toward men in uniform, but the respect for the soldier, sailor and marine cannot long survive if any appreciable number of those classes reduce the uniform to a means of making a living too easily and with no other pretense of rendering service for value received than a draft upon the sympathy of the citizen.

Probably the problem is not one which can readily be solved by any action of the federal authorities, since there is nothing to prevent a former enlisted man from wearing the uniform for a period after his discharge, but the municipal police officials might exercise their right to overhaul men in uniform who are engaged in street transactions, while the most effective method, probably, would be for those who have served in the military-naval establishment to take the situation into their own hands. They would seem to have the right to question any alleged or apparent comrade who is making himself obnoxious in this way. The street trafficking by men in uniform could not long survive this direct and positive interrogation. Shame on the part of the offending individual, if nothing else, would soon arrest the tendency wherever it is flagrantly in operation. Those who are guilty of this misuse of the uniform are, of course, in a vast minority anywhere, but they are made conspicuous on account of their apparel, and naturally, create an impression that is unfair to the thousands of young men who would be most vigorous in their denunciation of the practice. — *Army and Navy Register, Sept. 13.*

DRY AMERICA BY AN ENGLISH ARTIST.

The American correspondent of the London Daily News, born and reared in England, has been in this country long enough to see the manifold blessings accruing from Prohibition, and, what is of more importance, he has the courage to faithfully report facts as they are to his paper.

He admits that before coming to America he was not in favor of Prohibition, which fact really adds interest to his testimony and to his opinion as to what Prohibition means for America.

He believes and declares that if England had the same education and the same effective vote, England would look upon the liquor traffic in the same light as does America. This is undoubtedly true, and to those of open mind in England who cannot come to America to see for themselves, this correspondent's picture of dry America, as presented in the following paragraph from his article, is commended:

"This is really rather a big issue. My only reason for discussing it is that in this skyscraper I can take, like Moses on Mt. Pisgah, an elevated yet non-alcoholic view. I see in England social unrest, a failure in production and a rising drink bill. I see in America a country going dry, developing new pleasures, raising vast sums for noble objects, seizing the drug fiend by the throat, eagerly discussing world problems and teaching the people industrial unity by means of the picture palace, which shows to millions every night what I may call com-

mercial films, ranging from pineapple farms to ship building. On the average, every American, old or young, has a hundred lessons a year on the interdependence of trade at times when British men and women are often in the public house. This is not the whole story, but it does shatter the theory that improved methods of happiness mean strikes and lockouts."

This prophetic correspondent has a remedy for England's drink curse, which is suggested in his closing paragraph, as follows:

"The whole issue comes to this: If thy hand offend thee, cut it off. Make the sacrifice, and like George Bernard Shaw and other teetotal wits, you will get the results; decline sacrifice and you won't. You can't compromise by municipalizing the sacrifice. You can't put sacrifice under disinterested management. As I am the best fed, most luxurious Englishmen alive, I am the very man to recommend sacrifice for others, but then following the unskilled American workman, I am putting my money into five children and a Ford while my friends are filling their garages with froth for grandfathers." — *The American Issue, Sept. 13.*

DENTAL CORPS ORDERS FROM WAR DEPARTMENT.

DENTAL CORPS.

Lieut Col. Herman S. Rush report to commanding general Southern Department for assignment.

Lieut. Col. Frank L. K. Laflamme to West Point, N. Y., Military Academy, for duty.

Capt. Alvin E. Anthony to Fort Sheridan, Ill., general hospital 28, for duty.

Capt. Harold H. Buehler to Fox Hills, N. Y., general hospital 41, for duty.

Capt. Edwin M. Kennedy to Denver, Colo., general hospital 21, for duty.

Capt. Joseph E. Schaefer to Jefferson Barracks, Mo., for duty.

—*Army and Navy Register, August 30.*

Col. Samuel H. Leslie to Camp Pike, Ark., and report for duty.

Col. Robert T. Oliver to Washington and report to surgeon general for duty in his office.

Col. Robert H. Mills and Lieut, Col. Raymond W. Pearson to Camp Gordon, Ga., for duty.

Lieut. Col. John A. McAllister, Jr., to Camp Lee, Va., for duty.

Capt. Lynn H. Tingay to Camp Knox, Ky., for duty.

Capt. William B. Caldwell to Fort Myer, Va., for duty.

Capt. Maximilian P. Bergeron to Fort Des Moines, Iowa, general hospital 26, for duty.

William T. Williams to Camp Zachary Taylor, Ky., for duty.

—*Army and Navy Register, September 6.*

Capt. James B. Eastman, to Walter Reed General Hospital, D. C., for duty.

Capt. Thomas L. Spoon, to Washington for duty in attending surgeon's office.

Capt. Ernest P. Dameron, to Jefferson Barracks, Mo., for duty.

Capt. George J. Sibley, to Fort Logan, Colo., for duty.

—*Army and Navy Register, September 13.*

Lieut. Col. George I. Gunckel, to Columbus Barracks, Ohio, for duty.

Lieut. Col. Herman S. Rush, honorably discharged as lieutenant colonel only, to take effect Sept. 30.

Maj. William C. Webb, Jr., report in Southern Department for duty.

Maj. Charles C. Mann, to Camp Jackson, S. C., for duty.

Capt. Beverly M. Epes, to Williamsbridge, N. Y., general hospital 1, for duty.

Capt. Leslie A. Gould, to Fort McHenry, Md., general hospital 2, for duty.

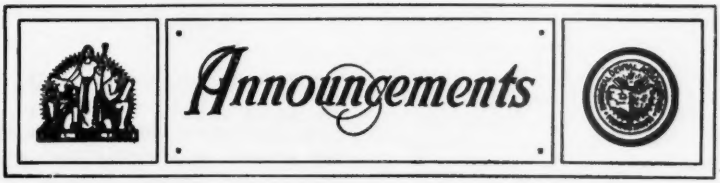
Capt. Francis M. Tench, to Fort Hancock, N. J., for duty.

—*Army and Navy Register, September 20.*

Lieut. Col. Lester C. Ogg, to Camp Shelby, Miss., for duty.

Maj. Arthur J. Hart, to Denver, Colo., general hospital 21, for duty.

—*Army and Navy Register, September 27.*



NATIONAL SOCIETIES, 1919.

October.

20-24—New Orleans, National Dental Association.

20-24—New Orleans, National Association of Dental Faculties.

18-20—New Orleans, National Association of Dental Examiners.

20—New Orleans, Delta Sigma Delta.

20-24—New Orleans, Xi Psi Phi Fraternity.

20-24—New Orleans, Association of Military Dental Surgeons.

17-18—New Orleans, International Society of Prosthetists.

20-24—New Orleans, Psi Omega Fraternity. Grand Chapter meeting and National Alumni Chapter meeting.

21-23—New Orleans, The American Society of Exodontists.

20-24—Conference of dentists operating in school dental dispensaries.

STATE SOCIETIES.

October.

21—Louisiana, New Orleans.

Rhode Island, Providence.

November.

3-4-5-6-7-8—Arizona, Phoenix.

December.

2-3-4—Ohio.

PSI OMEGA FRATERNITY.

Psi Omegas should be especially interested in this year's N. D. A. meeting in New Orleans the week of October 20th for the trip there will not only enable them to attend a splendid dental convention amid charming surroundings, but to also visit the triennial Grand Chapter meeting of the fraternity, which immediately precedes that of the National Dental Association.

The annual session of the National Alumni Chapter will be held on Monday.

The undergraduate and alumni chapter delegates, together with all other visiting Psi Omegas, will be banqueted on Monday night by the New Orleans members, who have also provided other forms of entertainment and sightseeing, at times not to conflict with the N. D. A. program.

Hotel Grunewald will be fraternity headquarters.

Additional information may be obtained from Dr. H. E. Friesell, Supreme Counselor, 1206 Highland Bldg., Pittsburgh, Pa., or Dr. Wallace Wood, Jr., Grand Master National Alumni Chapter, New Orleans, La.

Early reports indicate a large attendance. M. M. PRINTZ, Chicago, Ill.

XI PSI PHI FRATERNITY

The biennial meeting of the Supreme Chapter XI PSI PHI FRATERNITY will be held Friday and Saturday October 17th and 18th at the Grunewald Hotel. Officers and delegates must be present for roll call Friday 9 A. M.

The National Alumni Association will hold its annual meeting Monday, October 20th, Grunewald Hotel.

The annual banquet will be held Mon-

day, October 20th, 7 P. M., Grunewald Hotel.

Headquarters at the Grunewald Hotel will be maintained thruout the National meeting and members of the fraternity are requested to register upon arrival.

H. B. PINNEY,
Supreme Sec'y-Treas.,
25 E. Washington St., Chicago, Ill.

DELTA SIGMA DELTA FRATERNITY.

The thirty-fifth annual meeting of the Supreme Chapter of Delta Sigma Delta Fraternity will be held in the Elks' new Lodge Hall (which is about three blocks from the headquarters of the Fraternity), New Orleans, La., on Monday, October 20, 1919, at 9 a. m.

The regular order of business will be pursued, including action on the proposed amendments to the Constitution and By-laws; to be followed by initiatory exercises in the afternoon.

Headquarters of the Fraternity will be in the Grunewald Hotel. The annual banquet will be held in the Elks new Lodge Hall at 7 p. m. Those expecting to attend the banquet will greatly facilitate the work of the committee by making their presence known as early as possible on the day of the meeting.

By order of the Supreme Chapter.

R. HAMILL D. SWING,
Supreme Scribe.
CARL D. LUCAS,
Supreme Grand Master.

THE NATIONAL ASSOCIATION OF DENTAL LIBRARIANS.

The National Association of Dental Librarians will hold a meeting in New Orleans, October 20th, 1919, at the Grunewald Hotel.

All dentists interested in Dental Libraries are invited to attend.

A. F. ISHAM, D. D. S., President.
G. H. HENDERSON, L. D. S., D. D. S.,
Secretary-Treasurer.

ANNUAL MEETING OF THE AMERICAN ACADEMY OF PERIODONTOLOGY.

New Orleans, La., October 17-18, 1919.

The Sixth annual meeting of the American Academy of Periodontology will be held at New Orleans, October 17-18, 1919.

Council meeting the afternoon of Thursday, October 16, 3 P. M.

First session of the Academy Friday, October 17th, 10 A. M.

Final session Saturday, October 18th, 7 P. M.

The Academy to present to the National Dental Association a report covering recommendations on the technic of the Personal Care of the Mouth.

The work of the Academy for this year to consist of a symposium covering all phases in the treatment of Dental Periclasia, brought out by papers, illustrated by clinics and backed by reports on Scientific Investigation and Office Treatment by the Academy's committees under those titles.

All meetings of the Council and session of the Academy to occur in the Convention Hall, twelfth floor of Hotel Grunewald.

All dentists interested in Periodontia will be welcomed.

GRACE ROGERS SPAULDING,
Sec'y, Detroit, Mich.

ANNUAL MEETING OF NATIONAL ASSOCIATION OF DENTAL FACULTIES.

The annual meeting of the National Association of Dental Faculties will be held in Parlor E, Mezzanine Floor, The Grunewald Hotel, New Orleans.

The meeting will be called on Saturday, October 18, at 9 a. m., and will last thru Monday.

Very respectfully,
C. C. ALLEN, Secretary.

THE TEXAS STATE BOARD OF DENTAL EXAMINERS.

September 5, '19.

The Texas State Board of Dental Examiners will hold its next examination in Houston, Texas, at the Texas Dental College, beginning Monday, December 1st, 1919, and continuing thru December 4th. The written examinations shall be in the English language in the following subjects: Operative Dentistry, Prosthetic Dentistry, Chemistry, Histology, Pathology and Bacteriology, Anatomy, Orthodontia, Materia Medica, Therapeutics, Oral Surgery, Anesthesia and Physiology.

The practical examination shall consist of three separate operative cases and three prosthetic cases.

Each applicant must furnish his own patients, also all materials and instruments, a chair will be provided.

One gold foil filling, one amalgam filling, and a treatment such as extirpation of pulp, extraction of tooth, cleaning teeth will be required.

The Board at its discretion may change these requirements and substitute others.

PRACTICAL PROSTHETIC. Models for a full upper and lower denture must be furnished by the applicant, together with an anatomical articulator and mounted under the observation of the examiner, and the work continued to the point of readiness for investing.

One Richmond crown and one gold shell crown shall be constructed on a natural root fitted into a plaster model, root prepared and crowns constructed under the observation of the examiner.

Separate models mounted on an articulator are required for these two cases.

Each applicant must exhibit a diploma from a reputable Dental College and two letters of recommendation for satisfactory evidence of his or her good moral character, or satisfactory evidence that he or she has been regularly engaged in the legal practice of dentistry in any State in the United States for a period of three years next preceding application, shall be entitled to an examination without the presentation of a diploma.

A college shall be considered reputable whose entrance requirements and courses of instructions are as high as those adopted by the better class of dental colleges of the United States.

A general average of 80% is required before an applicant is eligible for a license.

The examination fee is $25.00 and must accompany all applications.

The Texas Dental Law does not provide for the issuance of a temporary license nor reciprocity with any other State.

Applications should be in the hands of the Secretary at least five days before the examination.

Yours very truly,
HARRISON B. CAVE, Secretary,
Wilson Bldg., Dallas, Texas.

THE CONNECTICUT STATE DENTAL COMMISSION.

The Dental Commissioners of Connecticut will meet at Hartford, November 20th, 21st and 22nd, 1919, to examine applicants for license to practice dentistry, to examine applicants for dental hygienist's license and to transact any other business proper to come before said commission.

For further information, address
EDWARD EBERLE, Recorder,
902 Main St., Hartford, Conn.

MARYLAND BOARD OF DENTAL EXAMINERS.

The Maryland Board of Dental Examiners will meet for examination of candidates for certificates in Baltimore on November 19 and 20, 1919.

For application blanks or further information apply to
F. F. DREW, Secretary,
701 N. Howard St., Baltimore, Md.

"Calsilith" now supplied (*in tin cans*) is ground much finer and sets much more rapidly than heretofore. Models made from it are exceptionally dense, smooth and hard, and resist most successfully prolonged subjection to moisture or superheated steam.

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5 So. Wabash Ave. **Chicago, U. S. A.**

INDIANA STATE BOARD OF DENTAL EXAMINERS.

The Indiana State Board of Dental Examiners will hold the next examination at the State House, in Indianapolis, November 17th to 22nd, inclusive.

For instructions and applications, write to H. C. McKittrick, Secretary, Indianapolis.

MARQUETTE UNIVERSITY DENTAL ALUMNI ASSOCIATION.

The Marquette University Dental Alumni Association will hold its meeting February 11, 12, 13, 1920 in the Milwaukee Auditorium, Milwaukee, Wisconsin.

V. A. Smith, Secy.,
755 Second St., Wilwaukee, Wis.

STATE OF NEBRASKA, DEPARTMENT OF WELFARE.

The Nebraska State Board of Dental Examiners will hold a regular examination at the Capitol and the Nebraska College of Dentistry, November 17,18, 19 and 20. For applications and information, address: Secretary Department of Public Welfare.

H. H. ANTLES, Secretary,
Department of Public Welfare.

SOUTH DAKOTA STATE BOARD OF DENTAL EXAMINERS.

The next meeting of the South Dakota State Board of Dental Examiners will be held in Sioux Falls, South Dakota, January 7th, 8th and 9th, 1920, beginning promptly at 9:00 A. M. January 7th.

All applications must be in the hands of the Secretary by January 1st. Fee for examination $25.00. No reciprocity or interchange. Full information and application blanks may be received by addressing

L. S. Spencer, Secy.,
Watertown, South Dakota.

BOARD OF REGISTRATION IN DENTISTRY.

The regular semi-annual meeting of the Rhode Island Board of Registration in Dentistry for the examination of applicants will be held in the State-house, R. I., November 4, 5, 6, 1919. All applications with proper fee must be filled one week previous. For further information address,

E. A. CHARBONNEL, Sec'y,
334 Westminster St., Providence, R. I.

JOURNAL OF DENTAL RESEARCH.

Dedicated to the advancement of scientific stomatology in all its aspects, and to the promotion of research in dentistry in particular.

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Edited by a large board of editors representing dentistry, and also the medical and biological sciences.

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Sample Copies sent to dentists upon application.

Editorial Office: Journal of Dental Research, Inc., College of Physicians and Surgeons, 437 W. 59th St., New York City.

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